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John M. Clarke, *Director*

SOME SILURIAN (ONTARIAN) FAUNAS OF NEW YORK

BY

RUDOLF RUEDEMANN

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New York State Museum, Albany

JOHN M. CLARKE, *Director*

SOME SILURIAN (ONTARIAN) FAUNAS OF NEW YORK

BY

RUDOLF RUEDEMANN

INTRODUCTION

The Silurian (Ontarian) fauna of New York was first made known to science in Hall's monumental Palaeontology of New York, where it comprises volume II and part of volume III. It has for a long time been recognized by students of Paleozoic fossils that a revision of volume II which appeared in 1852, or rather of the Silurian fauna of New York, is urgently needed.

The printing conditions at the present time do not encourage an undertaking of that scope; moreover large portions of the Silurian fauna have been dealt with in more recent publications. The more important of these are the monographs of the Guelph fauna and of the eurypterids by Clarke and Ruedemann and of the bryozoans of the Rochester shale by Doctor Bassler.

Large groups of our Silurian fossils are, however, still awaiting monographic treatment. Meanwhile, it seems desirable to publish new faunules that are discovered and use the occasion to revise the related longer known forms.

This bulletin is written mainly for the purpose of making known two faunules of the New York Silurian because of their important geologic bearing. One is the fauna of the Bertie waterlime at Buffalo, N. Y. The other is a large, mainly graptolitic fauna of a shaly channel in the Lockport limestone at Gasport, N. Y. Both of these remarkable faunas, replete with strange and uncommon types of forms, we owe to the untiring enthusiasm and industry of E. Reinhard of Buffalo, who has succeeded in increasing the number of known Bertie waterlime forms from the nineteen which Doctor O'Connell has cited in 1916 to forty-four, thus more than doubling a fauna in apparently barren and forbidding beds that had been searched for more than 70 years.

Equally interesting and novel is the faunule of the Gasport argillaceous channel that differs entirely from that of the surrounding Lockport limestone, a coral facies in that neighborhood.

There are described here also a number of new or little known species from the Cataract formation, Pittsford shale, Camillus shale, Rochester shale and Cobleskill limestone, and the occasion has been used to discuss a fossil of the Manitoulin limestone (Leveillites hartnageli Foerste) and to describe a new crustacean from the Kokomo limestone of Indiana.

Winifred Goldring has supplied a note on Hostimella.

We are sincerely grateful for the loan of material from the Bertie waterlime and Lockport limestone by Dr F. A. Bather, Dr R. S. Bassler, W. L. Bryant and Dr E. M. Kindle.

The photographs were carefully made by Messrs Edwin Stein and Erwin Pohl, the drawings by Mrs E. K. Bender and the author, all the outlines being obtained by the latter by means of a Leitz macroscopic drawing apparatus. The graptolites were photographed and drawn in with India ink on blue prints by the author.

THE GASPORT "CHANNEL" OF THE LOCKPORT LIMESTONE

In 1923, when the writer saw the Gasport shaly channel in the large quarry of the Wickwire Steel Co. at Gasport, N. Y., it consisted of a plano-convex body of shale, about 210 feet wide and about 15 feet deep in the center (see text figure 1). While it appears semilenticular in section, it probably is elongate, representing the filling of a depression or lagoon. It is intercalated in Lockport limestone beds, being underlain by dense, barren dolomite and overlain by Lockport limestone at the edge of the quarry. Laterally it passes with a jagged margin of interlocking layers into coralline and crinoidal beds of Lockport limestone and, therefore, represents an original depression between the reefs. These horizontally contiguous beds are full of stocks of Favosites, Syringophyllum etc., some of the stocks projecting into the channel. The channel rock itself, for the most part, consists of calcareous and argillaceous shale, sandy near the top and containing six thin layers of shaly limestone. By its dark brown color it contrasts strikingly with the light buff Lockport limestone.

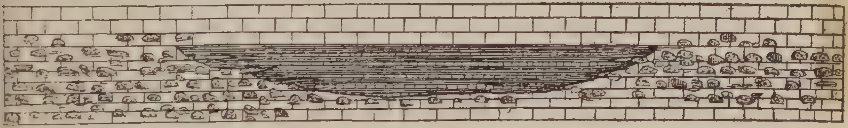

Figure 1 East-west section through Gasport lens or channel.

Our collection of fossils from the "channel" consists of the following species:

Chondrites verus *Rued.*
Ascograptus similis *Rued.*
Callograptus *cf.* minutus altus *Gurley*
Inocaulis plumulosus *Hall*
In. ramulosus *Spencer*
Desmograptus micronematodes (*Spencer*)
Dictyonema retiforme *Hall*
D. infundibuliforme *Rued.*
D. expansum *Spencer*
D. filiramus *Gurley*
D. crassibasale *Gurley*
D. tenellum *Spencer*
Acanthograptus walkeri (*Spencer*)
Calyptograptus cyathiformis *Spencer*
Diplospirograptus goldringae *Rued.*

Medusaegraptus mirabilis *Rued.*
Lingula lamellata *Hall*
Trematis spinosa *Rued.*
Tentaculites *sp.*
Conularia niagarensis *Hall*
C. tenuicosta *Rued.*
Protoscolex batheri *Rued.*
Dactylethra conspicua *Rued.*

The contrast between this fauna and that of the adjoining coralline Lockport limestone is as great as it possibly could be. In species and especially in number of individuals the fauna of the channel is overwhelmingly a dendroid graptolite fauna, while that of the neighboring facies is one of corals, crinoids, brachiopods, trilobites etc. It thus appears that in the channel there existed life conditions totally different from those of the enclosing coral reefs. The mud content of the channel beds indicates that the mud swept along in the channel prevented the growth of the corals, but made a favorable bottom for the dendroid graptolites, all of which were anchored in the mud, either by long tap roots or by disks. A majority of the forms are identical with species described by Spencer and Gurley from the shaly Lockport beds at Hamilton, Ontario. Besides these there also occur Inocaulis plumulosus and Dictyonema retiforme both of which are Rochester shale fossils that extend, as rare occurrences, into the Lockport limestone.

The most important members of the graptolite fauna of the Gasport channel are, however, Diplospirograptus goldringae[1] and Medusaegraptus mirabilis, both of which are common in the channel beds and so novel in structure that they represent new genera that are widely different from the other Dendroidea. The same is true of Ascograptus similis which, however, is a rarer form.

It is thus apparent that the Gasport channel represents a facies that is widely different from that seen in the closely adjacent Lockport limestone and that supported a peculiar fauna of its own, largely composed of Dendroidea.

THE BERTIE WATERLIME FAUNA

The fauna of the Bertie waterlime derives its interest and importance from its prevailing eurypterid content and the discussions that have arisen as to the habitat of the eurypterids.

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[1] Diplospirograptus, with its spiral axes, is according to Professor O. Abel, who was shown the material, a distinct adaptation to running water or to strong currents such as probably existed at times in the Gasport channel.

Doctor O'Connell (1916, p. 87) has cited the following faunas from the Bertie waterlime, differentiating the western or Erie district from the eastern or Herkimer district.

(*a*) Bertie fauna of Erie district:
Eurypterids
  Dolichopterus macrochirus
  D. siluriceps
  Eurypterus lacustris
  E. lacustris *var.* pachychirus
  E. pustulosus
  Eusarcus scorpionis
  Pterygotus buffaloensis
  P. cobbi
  P. grandis
Associated forms
  Cephalopods — Orthoceras undulatum
    Trochoceras gebhardi
  Brachiopod — Lingula *sp.*
  Ostracod — Leperditia alta
  Pelecypod — Goniophora *sp.*
  Pulmonate Gastropods — Hercynella buffaloensis
    H. patelliformis
  Graptolites — "Buthotrephis lesquereuxi" (formerly considered seaweed, now identified by Ruedemann as graptolites)
  Ceratiocarid — Ceratiocaris acuminata
  Plant — Chondrites graminiformis (may be a graptolite)

(*b*) Bertie fauna of Herkimer district:
Eurypterids
  Dolichopterus macrochirus
  D. testudineus
  Eurypterus remipes
  Pterygotus macrophthalmus
  P. cobbi
Associated forms — Scorpion
  Proscorpius osborni

This list has been materially changed in its aspect by the more recent collections of Mr Reinhard and others. It reads now (new forms marked by asterisk):

(*a*) Bertie fauna and flora of Erie district:
Eurypterids, same as above in O'Connell's list
Associated forms
Plants
  Algae
    *Calithamnopsis silurica *Rued.*
    *Morania (?) bertiensis *Rued.*
    *Sphenophycus (?) *spec.*

Corals
*Stromatopora *sp.*
*Ceratopora (?) *sp.*

Graptolites
Inocaulis lesquereuxi *(Grote and Pitt)*
*Palaeodictyota buffaloensis *Rued.*
Medusaegraptus graminiformis (*Pohlman*)
*Orthograptus (?) *sp.*
*Climacograptus ultimus *Rued.*

Cystids
*Pyrgocystis batheri *Rued.*

Bryozoans
*Stigmatella *sp.*

Brachiopods
*Lingula media *Rued.*
*Orbiculoidea bertiensis *Rued.*
Camarotoechia *cf.* andrewsi *Prouty*
*Spirifer (Delthyris) eriensis (*Grabau*)

Vermes
*Bertiella obesa *Rued.*
*Serpulites *sp.*

Mollusca

Lamellibranchs
*Rhytimya buffaloensis *Rued.*
Goniophora *sp.*

Gastropods
Hercynella buffaloensis *O'Connell*
H. patelliformis *O'Connell*
*Loxonema bertiense *Rued.*
*Hormotoma gregaria *Rued.*

Conularidae
*Conularia perglabra *Rued.*

Cephalopods
*Orthoceras *sp.*
Dawsonoceras oconnellae *Rued.*
Trochoceras *cf.* anderdonense *Grabau*
*Pristeroceras timidum *Rued.*

Crustaceans
Ceratiocaris acuminata *Hall*
C. maccoyana *Hall*
*Lepidocoleus reinhardi *Rued.*
*Emmelezoe minuta *Rued.*
Leperditia alta (*Conrad*)
L. scalaris (*Jones*)

Merostomes
*Bunaia woodwardi *Clarke*
*Hemiaspis (?) eriensis *Clarke*

(*b*) Bertie fauna of middle and eastern districts:

Eurypterids

Dolichopterus macrochirus *Hall*
D. testudineus *Clarke* and *Ruedemann*
Eurypterus remipes *Dekay*
Pterygotus macrophthalmus *Hall*
P. cobbi *Hall*
*Eusarcus trigonus *Rued.*

Associated forms

*Lingula subtrigona *Rued.*
*L. testatrix *Rued.*
*Orthoceras vicinus *Rued.*
*Phragmoceras accola *Rued.*
*Pseudoniscus clarkei *Rued.*
Proscorpius osborni *Whitfield*

A comparison of the two lists shows that the additions are all in the associated forms, that they consist of seaweeds, corals, graptolites, cystids, bryozoans, brachiopods, lamellibranchs, gastropods, cephalopods and crustaceans, or in other words, of marine fossils.

This is an important fact in view of the hypothesis advanced by Doctor O'Connell (1916, p. 106–18) that " where the Bertie is eurypterid-bearing, the rock was evidently deposited above sea level, as a river flood plain and subaerial delta deposit." Two rivers are assumed to have come to the sea from the north, one each for the eastern and western eurypterid faunas or " pools," and they are believed to have derived the calcareous mud that formed the Bertie waterlime and dolomite from the exposures of Niagaran and Trenton limestones.

We do not intend here to enter into a lengthy discussion of this elaborately worked out, genial hypothesis which is a corollary of the view that the eurypterids were denizens of the rivers; but wish merely to point out a few facts that can not be readily reconciled with this hypothesis.

The first fact is the large content of marine fossils in the Bertie waterlime, hitherto not observed. The list comprises forms of all classes of marine animals, observed in Silurian faunas. It could therefore be concluded that the Bertie waterlime actually contained a typical marine fauna. This is, however, not the case, for the majority of the new forms cited have been found only in few examples, and might therefore be well considered as stragglers carried into the delta during severe storms. This is in part supported by the fact that many of the shells, especially the molluscs, are poorly preserved. They are reduced to a mere film. This, however, is also the case with the shells of Hormotoma gregaria which are found in great numbers on some surfaces, and of Pristeroceras timidum, of which also a considerable number of specimens were obtained. The shadowy preservation of fossils on some of the slabs seems to us more to be attributed to an early and complete dissolution of the aragonitic shells in the dolomite mud, than to their long drifting about. Indeed, we are convinced that the scarcity of marine shells in the Bertie waterlime is largely due to their early complete dissolution.[1]

On the other hand, the more resistant chitinous tests of the graptolites and brachiopods are found in dense swarms on some beds. This is especially the case with Inocaulis lesquereuxi, Medusaegraptus graminiformis, Climacograptus ultimus and Lingula media. Climacograptus ultimus might have drifted in during storms, as Grabau assumes for most graptolites in black shales; but Inocaulis lesquereuxi and Medusaegraptus graminiformis are sessile dendroid graptolites which most probably grew near where they are found. This is undoubtedly so in the case of Medusaegraptus graminiformis, the young stages of which are found in upright position in the rock (see plate 8 figure 3). Also perfect colonial stocks of Inocaulis lesquereuxi, as that reproduced in plate 12 figure 2 can not have drifted far but must be *in situ*. Likewise is Lingula media so evenly distributed over the bedding planes that it appears as a native form and not as a straggler washed in and piled up.

We thus see in the new fauna here published fair evidence that the Bertie waterlime is an actual marine deposit.

Another significant fact overlooked by Doctor O'Connell is the gradual gradation of the Bertie waterlime into the overlying "Bull head" (Akron dolomite). Hartnagel has already pointed out (1905, p. 357) that in Ontario county the Bertie waterlime with eurypterids and the Akron dolomite with corals and other marine fossils alternate twice at the boundary. At Buffalo it is difficult to draw the line between the Bertie and Akron formations. The two formations are bound still closer together by the finding of eurypterids

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[1] The complete destruction of most fossils with calcareous shells through slow sedimentation and diagenetic processes has been pointed out by various authors (see especially Wepfer 1916) as causing the lack of fossils in limestone and dolomite beds. How complete this process is in the Bertie waterlime is shown by slabs covered with mere carbonaceous shadows of Lingulas, whose phosphatic shells have even been dissolved. Some surfaces (see plate 14, figure 5) are densely crowded with coprolites of unknown animals, no trace of which is left. All these observations testify to an abundance of life in the waters of later Bertie time in spite of the present barrenness of the rock.

(Eurypterus buffaloensis, Pterygotus), an Inocaulis and Medusaegraptus graminiformis in the Akron dolomite, and of the characteristic Akron fossils Spirifer eriensis and Leperditia scalaris (Jones) in the upper Bertie.

Now the Akron dolomite is the western continuation of the Cobleskill limestone, which in the east is a typical coral facies and was originally called the " Coralline limestone." Also the " Bull head " at Buffalo is still replete with specimens of Cyathophyllum hydraulicum.

The close connection of the Coralline limestone with the Bertie suggests the view that the Bertie is a lagoon deposit formed behind coral reefs. The coral reefs during Bertie time were farther south extending from east to west or rather southwest, the coast lying north and the pool running from east to west. This hypothesis would explain a host of facts much more readily than Doctor O'Connell's delta hypothesis; especially the wide horizontal extension and relative thinness of the Bertie waterlime; the presence of " hopper-crystals " (salt skeleton crystals) in the Bertie such as are also found in the Camillus and which indicate a highly saline condition of the water; the appearance of a number of strange fossils, as Calithamnopsis silurica, Inocaulis lesquereuxi, Palaeodictyota buffaloensis, Medusaegraptus graminiformis,[1] Pyrgocystis batheri, Bertiella obesa, the Hercynellas, Trochoceras, Pristeroceras timidum, Lepidocoleus reinhardi, the Ceratiocarids, Emmelezoe minuta, Bunaia woodwardi and Hemiaspis eriensis which point to conditions not normally marine, but well reconcilable with those existing in the broad lagoons behind the reefs. Considering that the Bertie is underlain by the barren Camillus shale, denoting salt pan conditions and overlain by the marine Akron dolomite, it follows that a sinking of the land with resulting gradual invasion of the sea from the south is to be inferred. It is significant in this connection that all the fossils of the Bertie, inclusive of the eurypterids, are found, according to Mr Reinhard, in the uppermost Bertie beds, where the purely marine conditions of the Cobleskill were approached. The presence of marine conditions indicating open sea at the same time in the south and southwest (Pennsylvania, Maryland and West Virginia) is brought out by the work of Swartz (1923, p. 40–50) in Maryland.

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[1] It is here worth while pointing out that the only other Medusaegraptus so far known, namely, M. mirabilis Rued. occurs in the Gasport channel close to the Lockport coral reefs.

It is impossible to say which of the Bertie fossils could have been fresh water animals that were carried out to sea. The Hercynellas which were considered so by Doctor O'Connell are certainly marine (see postea p. 52). This leaves the plants, crustaceans, merostomes and the scorpion.

The status of the problem of the habitat of the eurypterids has been recently discussed by the writer (1924, p. 227) from the investigations of Versluys and Demoll. It appears from their thorough anatomic studies that the merostomes were probably derived from primitive scorpionlike ancestors that entered the sea from the land.

The finding of groups of eurypterid brood, like that reproduced in plate 24, figure 5, refutes the assertion of Grabau and O'Connell that the eurypterid remains were carried out to sea by the rivers, for there can not be any doubt that these very minute eurypterids (about 2.5 mm long) obviously very early growth-stages, could not have been transported into the sea single and still less in groups, but obviously were hatched near where they or perhaps their moulted skins were found.

As to the scorpion of the Bertie waterlime, which was considered by Clarke and Ruedemann (1912, p. 387 ff.) as a marine form, but by Pompeckj (1923, p. 331), with the other Silurian scorpions, held to be a land animal, it is pointed out by Abel (1924, p. 125, 126) that absence of stigmata, the blindness of Palaeophonus and the development of the ocelli in Proscorpius, as well as the structure of the legs, leave no doubt that these scorpions were secondarily adapted to water. Since all have been found in marine beds there is no reason to assume that they were fresh water forms.

On the other hand, evidence is accumulating that Limulus originated as a fresh water form (see Kirchner, 1923, p. 639). If the eurypterids as well as Limulus are derived from land animals, as Versluys and Demoll infer, it is quite probable that we have to see in the Xiphosura (Limulus, Belinurus, Prestwichia etc.) that branch of the merostomes that adapted itself to the fresh water and in the Synxiphosura (Aglaspis, Hemiaspis, Bunodes etc.) and in the Eurypterida those branches that adapted themselves to marine conditions. The fossil Xiphosura are practically all undoubted fresh water forms. Limulus is the only exception (but is secondarily marine), while in the Synxiphosura and Eurypterida the weight of the evidence is in favor of marine habitats. Considering that these creatures entered the sea from the land, it is readily understood why they preferred the quiet lagoons behind coral reefs and other barriers.

DESCRIPTIONS OF FOSSILS

I PLANTAE

Callithamnopsis silurica nov.

Plate 4, figure 4

Description. Fragment of thallus observed, consisting of main branch bearing whorls of branchlets at regular intervals, which in turn divide at shorter intervals into whorls of branchlets of a higher order. The nodes are slightly inflated and through their darker color indicate an original thickening of the thallus. The branchlets appear relatively stout and stiff in the basal portions that are preserved. A fragment lying near the specimen may be a part of a branchlet of similar character.

Measurements. The fragment is 16 mm long, .5 mm wide and the whorls are, on the main branch, 5 mm apart. The branchlets subdivide 2 mm from the base.

Horizon and locality. Bertie waterlime near Buffalo, on slab with specimens of Hormotoma gregaria Rued.

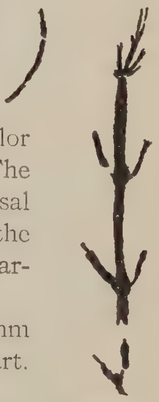

Figure 2. Callithamnopsis silurica Rued. Holotype x3.

Remarks. This interesting little alga is the first representative of the genus Callithamnopsis described from the Silurian. The genus is based on forms from the "Trenton" shale of Wisconsin (see Whitfield, 1902, p. 354)[1] and the Glens Falls limestone (basal Trenton) of New York (Ruedemann, 1909). From the earlier species the Silurian form is readily distinguished by the greater distance between the whorls of branchlets on the main branch and the shorter "internodes" of the branchlets. The Mohawkian species are marine and the same is probably true of the Silurian form.

Chondrites verus nov.

Plate 4, figure 5

The genus Chondrites of fossil "algae" has been under a cloud for many years, partly because, as in Fucoides, Caulerpites and others, the name has been applied to indefinite and indistinct surface markings which happen to resemble in shape certain of the better known genera of recent seaweeds (Seward, 1898, p. 142), and partly since

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[1] The locality is Platteville, Wis., and the horizon probably the Upper Platteville limestone, which is of early Black River age.

Nathorst has shown that many of the species of Chondrites, Cruziana, Spirophyton, Eophyton etc. are inorganic and animal markings. (*Id.* p. 144).

On the other hand, there are known a number of undoubted algal remains which bear a close resemblance in their habitus to the recent genus Chondrus and other Rhodophyceae, and which, therefore, may be compared with the latter without danger of misleading conclusions. To this undoubted algal remains also belongs the form here reproduced on plate 2, figure 5, as Chondrites verus.

This fossil from the Gasport lens of the Lockport limestone retains a distinct carbonaceous film, leaving no doubt of its organic nature. The principal characters of the thallus are a fairly slender, dichotomously branching stem, originally probably cylindrical and terminating in clusters of ribbonlike expansions of the thallus, produced by dichotomous division. The latter contrast by their apparent flexuous character with the more rigid, erect stems.

The thallus is about 10 cm high, the stem 2 mm wide, the furcations of the stem 3 cm apart; the bandlike expansions are 3-6 cm long and about 3 mm wide.

Morania (?) **bertiensis** nov.

Plate 4, figure 1

The Bertie waterlime at North Buffalo contains nondescript fossils, a representative specimen of which is figured in plate 1, figure 1. This appears as an irregular, subcircular carbonaceous film, slightly lobed along the margin of one side, while that of the other side is continuous and well defined. The carbonaceous film lacks all traces of structure; it is, however, thick enough to indicate the original presence of a substantial amount of organic matter. In the overlying rock three transverse curved ridges are seen, which appear as foldlike projections of the basal film, but are filled with crystalline calcareous matter and may belong to an independent body.

The flat, carbonaceous body could be compared with the mucous, gelatinous or membranaceous tegument forming the sheaths that surround the thallus of the Nostocaceae. There is, of course, no evidence for or against such assumption except the general form and carbonaceous substance of the fossil. Walcott (1919, p. 225) has described and figured a whole series of irregular carbonaceous bodies from the Middle Cambrian of British Columbia, referring them to the Nostocaceae and uniting them under the new genus *Morania*.

We can do no better than refer our fossil to that genus of Cambrian algae.

Sphenophycus (?) sp.

Plate 4, figures 2, 3

In 1912 (p. 74) the writer described as algal flotation appendages club-shaped bodies which have been found associated and in one case attached to remains of Sphenophycus latifolius Hall, in the Schenectady beds (Ordovician) of New York. The remains here figured, especially that represented by figure 2, are very similar to these supposed gas bulbs of Sphenophycus and may therefore be also described as being of the nature of algal flotation appendages.

Hostimella P. & B.

BY WINIFRED GOLDRING

Under this genus have been described plant remains from the Lower Devonian of Röragen, Norway, and the Middle Devonian of Bohemia. These plant remains, first described as seaweeds, are now recognized as of a terrestrial nature (Potonié, H. and Bernard, C., Flore Devonienne de l'etage H de Barrande, p. 18, 1904, in Syst. Silur. du Centre de la Bohême by J. Barrande) though their relationship is not established. Arber (1921, Devonian Floras) refers to the examples of this genus as still entirely obscure objects, appearing to stand nearest to Psilophyton. Two varieties have been described, H. hostimensis P. & B. α) typica, H. hostimensis P. & B. β.) rhodeaeformis.

Hostimella silurica Goldring

Plate 5, figures 1 and 2

This Silurian plant from the Bertie waterlime has been placed in this genus, because, while of obscure nature, it has the general habit of the described species of Hostimella, bearing closer resemblance to the first described type, typica. The dichotomous branching resulting in unequal branches is well shown. The wider branches follow the direction of the main axis and the smaller branches occur on alternate sides, giving the effect of a main stem with alternately arranged branches. The larger of the two specimens figured had a small amount of carbonized tissue still attached, but attempts to find structure gave no results. Pitted vessels and fibres were found by Potonié and Bernard in the Devonian material.

In this connection may be also mentioned a large rootlike plant remains (see plate 16, figure 1) from the Bertie waterlime at Buffalo, now in the Buffalo Museum (No. 13309).

E1638)

It resembles a large tap root, measuring (incomplete) 395 mm in length, and tapering in that length from 37 mm to a fairly acute extremity. There are no traces of appendages or of bases of such. The fossil consists of a thick layer of anthracite (1 mm thick in parts), which, however, exhibits no traces of whatever structure. It is therefore entirely on the outline and substantial carbon deposit that our reference of this remains to the land plants is based.

There is no evidence on which a reference of this fossil to the seaweed Nematophycus crassus (Penhallow) found in the Akron (Bull head) of North Buffalo could be based.

II GRAPTOLITOIDEA

Ascograptus gen. nov.

(Greek Ascon = tube)

Rhabdosome consisting of axial tube, from which separate conical thecae arise in spiral arrangement.

Genotype. Ascograptus similis nov.

Ascograptus similis nov.

Plate 6, figures 1–8

Description. Axial tube slender (diameter 0.2 mm); cylindrical; thecae elongate conical, to elongate pyriform, about 6 times as long as wide (1.0 to 1.5 mm long and .25 mm wide), numbering 3–15 or more; aperture round, open, somewhat contracted; base of thecae a slender tube.

Horizon and locality. In sandy lens of Lockport limestone at Gasport, N. Y.

Remarks. In seeing these minute radial clusters, one is readily led to refer them to the bryozoan Ascodictyon and to compare them with the A. siluriense Vine, that occurs besides in Great Britain also in the Rochester shale of New York and the Waldron shale of Indiana and Tennessee. On closer study, however, doubts arise as to the correctness of such a reference in spite of the close exterior similarity. Firstly, no connecting hollow threads between the radial clusters of vesicles can be found; it is, however, possible that these might have failed of preservation, if ever present; and it is to be mentioned in this connection that the five more complete specimens here figured were all found on an area of a square inch and therefore might well have all belonged together. But they are not on exactly the same level of the rock and there is nothing to indicate that they were parasitic on any shell, as the zoaria of Ascodictyon always are. They are free on the surface of the rock and moreove the arrangement of the thecae in a radial cluster, open on one side and rising from one end of the series to the other in the rock leaves hardly any other explanation than that the thecae had a spiral arrangement, on a vertical axis, that in the specimens is seen only in section and that probably stood erect on the muddy bottom of the sea, being anchored by a threadlike root. The straight transverse terminal edges of most of the thecae indicate the presence of a subcircular aperture. In several cases the aperture itself is seen compressed obliquely with what may have been slightly produced opposite lappets of the margin.

The thecae appear as carbonaceous impressions, indicating an originally chitinous substance. Closely arranged, minute pores such as are observable on the vesicles of Ascodictyon, have not been seen, but, on the other hand, no traces of siculae or growth lines have been found. Therefore, while we, on account of the differences from Ascodictyon here noted, do not believe that the organisms can be referred to the bryozoans, there is not sufficient evidence to prove their graptolite nature. They would represent an aberrant primitive group of the Dendroidea, related to Corynoides and preserving in the thecae the original conical form of the sicula.

Acanthograptus walkeri (Spencer)

Specimens of Acanthograptus walkeri have been obtained in the Gasport lens of the Lockport limestone. Two of these have been figured here. Spencer's original material came from the same horizon at Hamilton, Ontario.

The species has also been found in the Rochester shale at Middleport, N. Y., and has been fully described

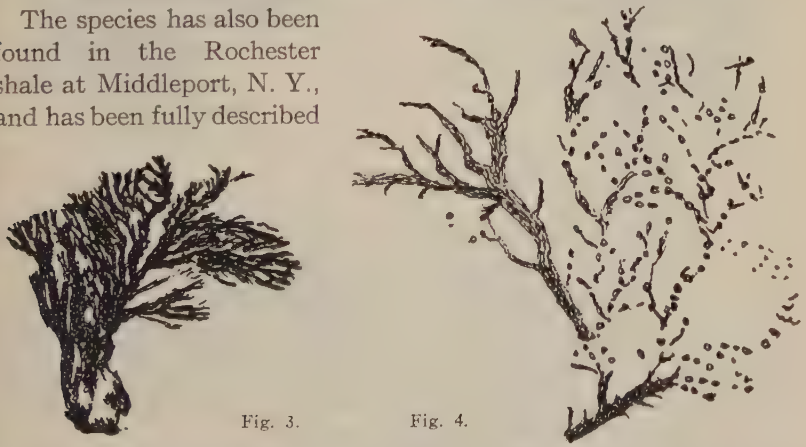

Fig. 3. Fig. 4.

Figures 3 and 4 Acanthograptus walkeri Spencer.

Figure 3 Specimen, natural size. Figure 4 Another pyritized specimen, x 3, showing the ropy structure of the stem and the sections of the projecting thecae.

from the collection obtained there by the writer (1908, p. 194). One specimen is pyritized and exhibits beautifully the composition of the entire stem of a ropy mass of twisted tubes and the tubular (circular) sections of the projecting thecae.

Callograptus cf. **minutus altus** Gurley

The specimen before us agrees in its general habit, as well as the dimensions of the branches with the variety altus Gurley (see Bassler, 1909, p. 15) of Spencer's species Callograptus minutus. It is, however, 3 times the size of Gurley's type, a difference which may be attributed to the fact that both Spencer's and Gurley's types were but young individuals. Our specimen measures 19 mm in width and 28 mm in height; the delicate, frequently bifurcating branches are .2 mm wide and separated by intervals of about .5 mm. The thecal apertures do not project and are closely arranged.

Our specimen came from the Gasport lens of the Lockport limestone, Spencer's from the same formation in Ontario, Canada.

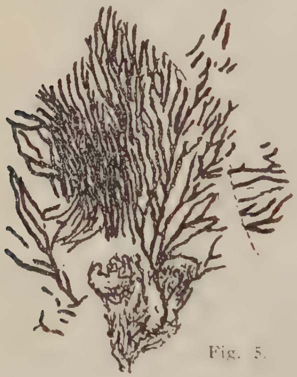

Fig. 5.

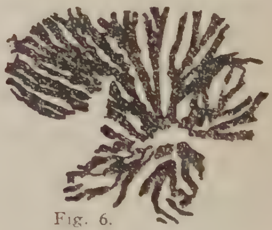

Fig. 6.

Figure 5 Callograptus cf. minutus altus Gurley. Natural size.

Figure 6 Calyptograptus cyathiformis Spencer. Natural size.

Calyptograptus cyathiformis Spencer

Calyptograptus cyathiformis Spencer. Canadian Nat., VIII 1878, p. 458, 460; Trans. Acad. Sci. St Louis, IV, 1884, p. 564, 578, pl. 3, fig. 3; Bul. Mus. Univ. State Missouri, I, 1884, p. 28, pl. 3, fig. 3; Miller, North Amer. Geol. and Pal. 1889, p. 175, fig. 145; Gurley, Jour. Geol. 1896, p. 93, 308; Bassler, Bul. U. S. Nat. Mus. 65, 1909, p. 38–39, fig. 48.

A characteristic specimen of this species, hitherto known only from the Lockport limestone at Hamilton, Ontario, has been found in the Gasport lens of the Lockport limestone at Gasport, N. Y. It affords no additional data to Spencer's careful description.

Dendrograptus rectus Ruedemann

A specimen of this beautiful graptolite, described and hitherto known only from the Clinton shale, overlying the lower ore bed (see Ruedemann, 1908, p. 145) has been obtained in the Rochester shale at Lockport, N. Y.

Desmograptus micronematodes (Spencer)

Calyptograptus micronematodes Spencer. Canadian Nat., X, 1882, p. 165, nomen nudum; Trans. Acad. Sci. St Louis, IV, 1884, p. 564, 579, 588, pl. 3, figs. 4, 4a; Bul. Mus. Univ. State Missouri, I, 1884, p. 14, 29, 38, pl. 3, figs. 4, 4a; Bassler, U. S. Nat. Mus. Bul. 65, 1909, p. 39-40, figs. 49, 50; Bassler, U. S. Nat. Mus. Bul. 92, 1915, p. 170.

Calyptograpsus micronematodes Gurley, Jour. Geol. IV, 1896, p. 93, 308.

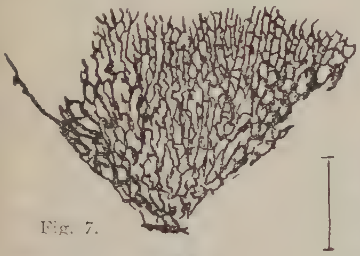
Fig. 7.

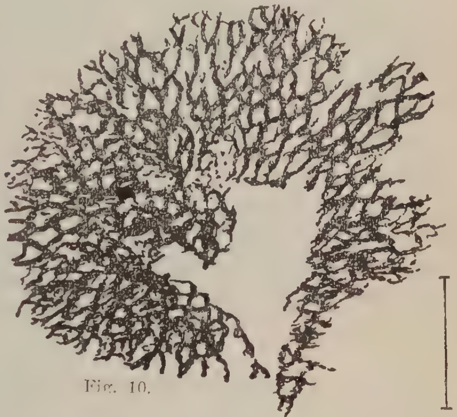
Fig. 10.

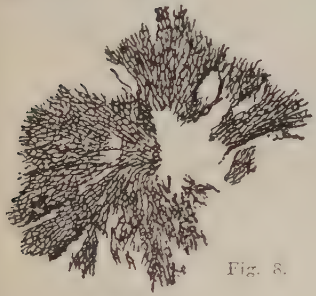
Fig. 8.

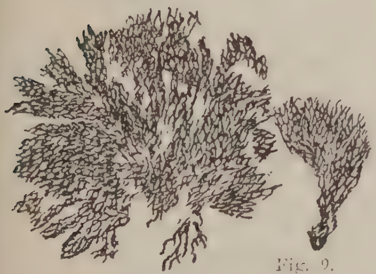
Fig. 9.

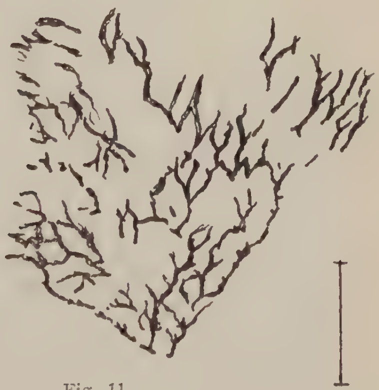
Fig. 11.

Figures 7–11 Desmograptus micronematodes (Spencer).

Figure 7 Specimen exhibiting lateral view and showing flat, disklike base. Figure 8 Top view of flattened specimen. Natural size. Figure 9 Lateral view of specimen. Natural size. Figure 10 Top view of young flattened specimen. Figure 11 Fragmentary rhabdosome with slightly wider meshes, from the Clinton sandstone at Niagara Falls.

Spencer had " only two or three specimens of this beautiful little frond " and Bassler found only a single specimen in the Spencer collection. Spencer had obtained his material near the base of the Niagara dolomite (Lockport limestone) near Hamilton, Ontario. In the Gasport lens of the Lockport limestone at Lockport, N. Y., the delicate little graptolite seems to be a little more common, for we have fourteen specimens at hand from that locality. These permit the following data to be added to Spencer's description:

Rhabdosome broadly cyathiform, growing from a flat basal disk, attaining a width of 45 mm; smooth in the basal part, but later becoming more or less folded. The branches undulating and coming regularly into direct contact with the neighboring branches or connected with them by short thick dissepiments; they form thus in some parts a true Desmograptus, in others approaching the Dictyonema structure. The meshes thus formed are elliptic or biconvex in outline, 1 to 1.5 mm long and .6 mm wide (about 8 in 5 mm); the branches are 2.5 to 3 mm wide. No thecal apertures or projecting thecae (denticles) have been seen.

Although Spencer described this form under his genus Calyptograptus, the structure of the rhabdosome with its undulating, regularly coalescing branches is decidedly that of a Desmograptus and not that of the genotype of Calyptograptus, namely C. cyathiformis.

Dictyonema crassibasale Gurley

Plate 1, figure 1

Dictyonema gracile Spencer (not Hall), Trans. Acad. Sci. St Louis, IV, 1884, p. 573, 574, pl. 2, figs. 2, 3; Bul. Mus. Univ. State Missouri, I, 1884, p. 24, pl. 2, figs. 2, 2*a*, 3; Bassler, U. S. Nat. Mus. Bul. 65, 1909, p. 19-24; figs. 21-25; pl. 3, fig. 1; Bassler, U. S. Nat. Mus. Bul. 92, 1915, p. 422.

Dictyonema crassibasale is the commonest and largest of the Dictyonemas of the wonderful dendroid fauna discovered at Hamilton, Ontario. Gurley (Bassler, 1909, p. 21) reports a specimen, " indicating a diameter for the whole polypary of nearly half a meter." The New York State Museum possesses a perfect specimen from the same locality, here reproduced in plate 1, figure 1, showing a diameter of 10 inches.

This species is also common in the Gasport lens of the Lockport limestone at Lockport. We figure here a specimen in which two portions of the broadly cyathiform rhabdosome overlap in such a way as to suggest that the rhabdosome may have grown upward in a flat spiral. The large specimen here figured indicates a very flat saucer-shaped form of the rhabdosome, with a broadly conical central portion.

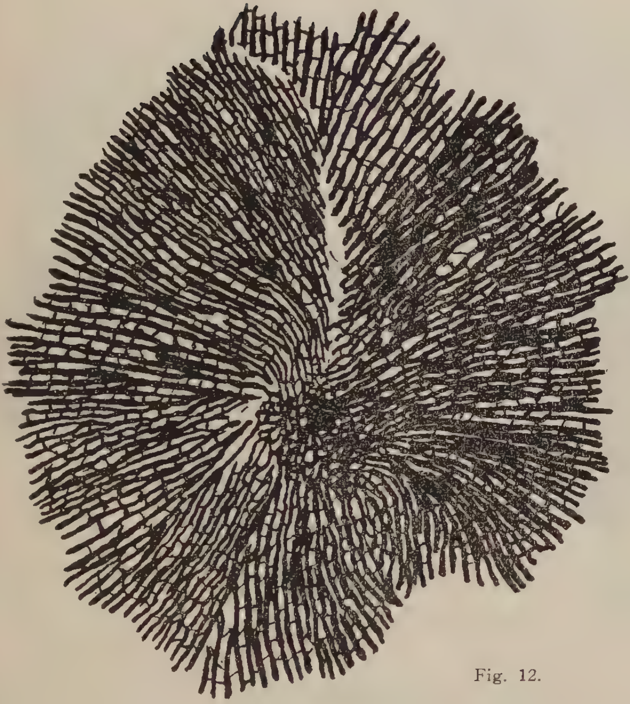

Fig. 12.

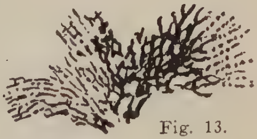

Fig. 13.

Figures 12 and 13 Dictyonema crassibasale Gurley.

Figure 12 Young specimen; natural size. Figure 13 Basal fragment, showing rows of thecal apertures at the right.

Dictyonema expansum Spencer

Dictyonema expansum Spencer. Acad. Sci. St Louis, IV, 1884, p. 504, 575, 576, pl. 2, fig. 1; Bul. Mus. Univ. State Missouri, I, 1884, p. 14, 25, 26, pl. 2, fig. 1; Gurley, Jour. Geol. IV, 1896, p. 96, 308; Bassler, U. S. Nat. Mus. Bul. 65, 1909, p. 31–34, figs. 36, 37; Bassler, U. S. Nat. Mus. Bul. 92, 1915, p. 423.

The presence, in the Gasport lens of the Lockport limestone at Lockport, N. Y., of this species is indicated by several fragments, one of which is figured here. The species is found in large flabelliform rhabdosomes in the Lockport limestone at Hamilton, Ontario. It is fully described by Gurley (see Bassler, 1909, p. 31).

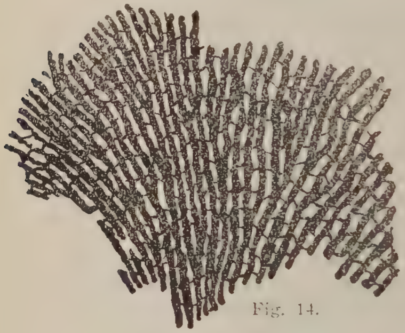
Fig. 14.

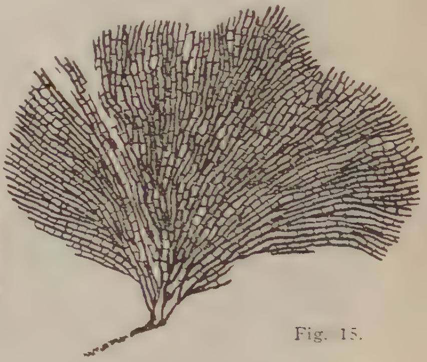
Fig. 15.

Figure 14 Dictyonema expansum Spencer. Fragmentary rhabdosome. Natural size.

Figure 15 Dictyonema filiramus Gurley. Specimen figured in natural size.

Dictyonema filiramus Gurley

Dictyonema filiramus (Gurley *ms.*) Bassler, U. S. Nat. Mus. Bul. 65, 1909, p. 34, fig. 38–40; Bassler, U. S. Nat. Mus. Bul. 92, 1915, p. 423.

This extremely delicate form from the Lockport limestone at Hamilton, Ontario, can be recognized in the fine complete rhabdosome here figured. In dimensions the latter is a little coarser than the Hamilton specimens; the width of the branches being throughout .4 mm and the number of branches hardly more than 35 in 25 mm against the 40 estimated by Gurley.

Dictyonema infundibuliforme nov.

Description. Rhabdosome infundibuliform; in the type specimen 9 cm high and about 11 cm wide at the upper margin; the lateral margins forming approximately a right angle. In another specimen they form only half that angle. The branches are rigid, very straight, bifurcating at infrequent intervals; throughout .8 mm wide and 1 mm apart; numbering 17 in 25 mm. The dissepiments are thin and are about 5 mm apart; the meshes about 5 times as long as wde. Flat basal disk.

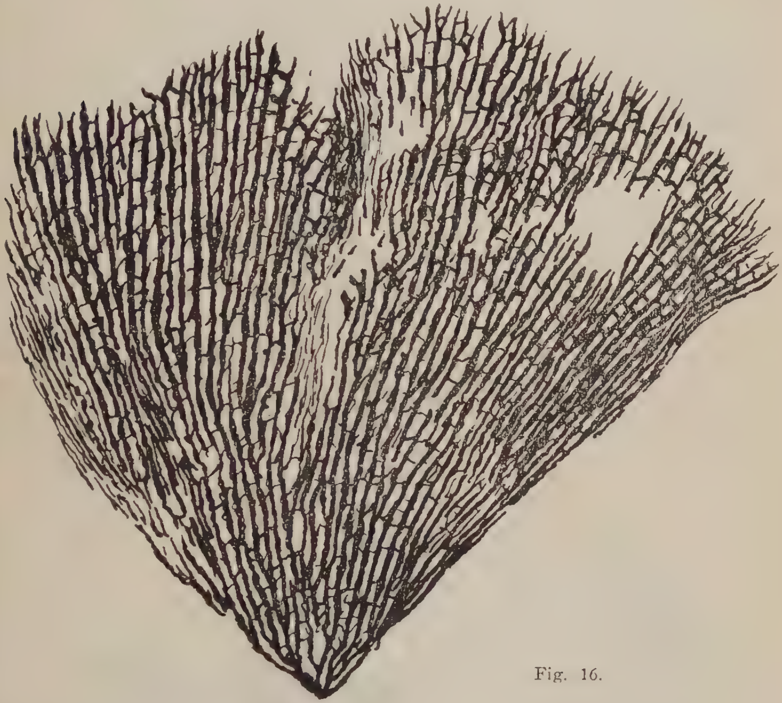

Figure 16 Dictyonema infundibuliforme Ruedemann. Holotype, natural size.

Horizon and locality. Gasport lens of Lockport limestone, Lockport, N. Y.

Remarks. This species is closely related in the character of the branches to D. expansum Spencer and D. percrassum Gurley, especially the former. It is readily distinguished from both by its infundibuliform habit of growth.

Dictyonema retiforme Hall

Several fragmentary specimens from the Gasport lens of the Lockport formation are referable to D. retiforme, a species that in New York finds its principal distribution in the Rochester shale (see Hall, 1852, p. 174; Ruedemann, 1908, p. 155). In Ontario it is found in the more shaly dolomites of the Hamilton, Ontario section (Bassler, 1909, p. 19).

Dictyonema tenellum Spencer

Dictyonema tenella Spencer. Canadian Nat., VIII, 1878, p. 458, 459.

Dictyonema tenellum Spencer. Canadian Nat. X, 1882, p. 165; Trans. Acad. Sci. St Louis, IV, p. 564, 576, (not pl. 1, fig. 13); Bul. Mus. Univ. State Missouri, I, p. 14, 26 (not pl. 1, fig. 13); Miller, North Amer. Geol. & Pal., 1889, p. 185; Gurley, Jour. Geol. IV, 1896, p. 96, 308; Bassler, U. S. Geol. Surv. Bul. 65, 1909, p. 28–30, pl. 2, fig. 4, figs. 32, 33; Bassler, U. S. Geol. Surv. Bul. 92, 1915, p. 427.

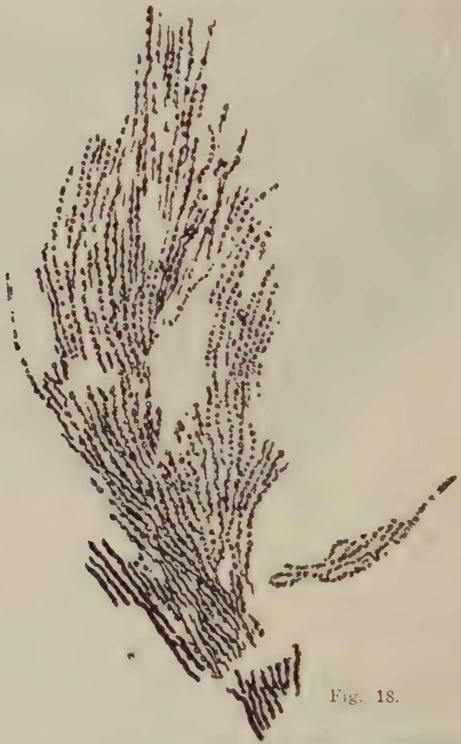

Fig. 18.

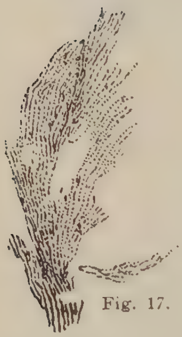

Fig. 17.

Figures 17 and 18 Dictyonema tenellum Spencer.
Figure 17 Specimen from Gasport lens. Figure 18 Same x 2 to show the

Two fragments of this delicate graptolite are contained in our collection of fossils from the Gasport lens of the Lockport limestone at Lockport, N. Y.

The species has been fully described by Spencer and Gurley (see Bassler, 1909). One of our specimens (here figured) is so preserved that the branches have partly weathered away and left in the rock the series of projecting thecae, now seen in circular sections. The specimen shows thereby that the thecae of the feeding individuals were all projecting on one side only, as usual in Dictyonema, and numbered 22–26 in 10 mm.

Inocaulis plumulosus Hall

The genotype of the genus Inocaulis, I. plumulosus Hall, has been quite fully described by the writer in the Graptolites of New York (1908, p. 188.) The short tubular processes of the stems representing the thecae and the pores from which they arise, were there noted and figured.

We describe in another place in this bulletin and figure the complicate interior structure of the stems or stipes of I. lesquereuxi, consisting of bundles of ropelike twisted fibers. A similar composition of the branches of I. plumulosa of black (originally chitinous ?) fibers is also seen in a few specimens. The fibers are, however, not spirally twisted in the cases seen, as in the other species, but are parallel to the general direction of the branch.

Inocaulis lesquereuxi (Grote & Pitt)

Plate 12, figures 1 and 2

Inocaulis lesquereuxi was originally described as a seaweed. Its graptolite nature has been shown by the writer (1916, p. 13) and the form fully described. It is therefore not necessary to enter here again into a discussion of this interesting fossil.

We wish, however, to publish a figure of a beautifully preserved perfect colonial stock, a foot in width, which has come to hand through the collecting ardor of E. Reinhard, and which gives a fair idea of the bushlike habit of this thick-branched, stately graptolite.

In the former publication we described the marginal projecting thecal tubes and the punctae or pores of the surface of the branches. Excellent material has now been afforded from the Buffalo quarries, in which the stipes were macerated before burial in the mud to such an extent that the composition of the interior of the stipes of more or less spirally twisted bundles of fibers is shown. In some cases the whole mass of fibers has been separated into ropelike bundles of twisted fibers, as many as seven of which were counted at the same level, indicating a quite complicate interior structure of the stipes.

Still another detached branch is figured here, because it exhibits a club-shaped swelling of the terminal portion of a branch, the meaning of which is not known at present.

Inocaulis ramulosus Spencer

Inocaulis ramulosus Spencer, Trans. Acad. Sci. St Louis, IV, 1884, p. 565, 588, 589, pl. 6, fig. 1; Bul. Museum. Univ. State Missouri, 1, 1884, p. 15, 38, 39, pl. 6, fig. 1.

Inocaulis ramulosus Bassler, Smithson. Inst. Bul. 65, 1909, p 49–50, figs. 63, 64.

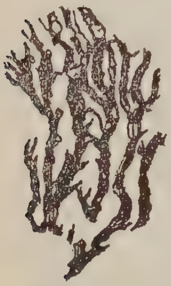

Figure 19 Inocaulis ramulosus Spencer. Fragment. Natural size.

The Gasport lens of the Lockport limestone at Gasport, N. Y., has afforded several specimens of this species that was hitherto known only from the Lockport limestone at Hamilton, Ontario. It has been fully described by Spencer and Gurley (Bassler, p. 50). We may add to this, that the branches of the specimen here figured, exhibit small oval apertures, not more than .2 mm wide in largest diameter. While most of the branches appear smooth, one of them (on left margin of specimen) exhibits a series of liplike processes of the apertures.

Inocaulis akronensis nov.

The Akron waterlime at Akron, N. Y., has afforded to Mr Reinhard two blocks which contain, on one surface, numerous fragments of an Inocaulis that is distinguished from the Bertie species I. lesquereuxi by its much smaller dimensions; the branches being, on the average only 1.5 mm wide, with 2 mm apparently as a maximum. It resembles in the size of the branches some of the congeners from the Lockport limestone, as I. ramulosus and diffusus Spencer. The material at hand is not sufficient to distinguish it from these earlier species, yet it is reasonably certain that it is not identical with any of the Lockport species, by reason of the long time interval and the fact that no other forms are common to the two widely separated formations.

None of the fragments is longer than 13 mm; the bifurcation seen in one fragment, takes place by a very small angle (less than 10°). The fragments suggest a certain rigidity or straightness of the branches.

The fingerlike projecting thecal tubes are finely seen on some of the branches. They are as figured by the writer from Inocaulis plumulosus Hall; but quite minute, about .9 mm to 1 mm long and .15 mm to .2 mm wide.

Leveillites hartnageli Foerste

Doctor A. F. Foerste (1923, p. 62) has elaborately described a Leveillites hartnageli a beautiful fossil from the Silurian Manitoulin limestone at Credit Forks, Ontario.

It is shown by Doctor Foerste that the frondlike expansions bear a middle axis and consist of anastomosing black fibers. In addition to these, series of black dots are seen to occur, about 5 or 6 in a width of .5 mm, from which hairlike fibers extending beyond the margins of the lobes can be traced. Doctor Foerste argues rightly that the fibers have too much consistency to be comparable with the fibrous structures traversing the interior of algae and possessing a very small quantity of carbon. It is stated that the fibers resemble the fibers of sponges more than those of plants, but a reference to the sponges is rejected because there is no trace of oscula or other characteristic structures of sponges. It is added (p. 61): " Possibly they belong to some group of animals not yet discriminated from those recognized so far."

The name is given from the resemblance to the fronds of the living alga Leveillea jungermannoides (Mart. & Her.) Harvey.

When we first saw the fine specimen collected by Mr Hartnagel in 1913 our impression was that the fossil would finally prove to be a hydrozoan. The study of the graptolites of the genus Diplospirograptus here described leads the way to the understanding of Leveillites. There is no doubt in our mind that Leveillites is closely related to Diplospirograptus and that the apparent flat frondose lobes are really bundles of thecal tubes such as are seen to proceed from the double spiral axis in Diplospirograptus. The rows of black dots are either the apertures of the thecae or the attachment places of the hairlike fibers.

As Chapman has shown Mastigograptus and other similar forms to be hydrozoans, this genus may also finally be brought under the Hydrozoa and the writer's original vague impression turns out to have been correct.

Medusaegraptus gen. nov.

Μέδουβα Medusa + γράφειν to write

Diagnosis. Rhabdosome consisting of simple, not branching stipe, which is a uniformly thick tube, ending in a blunt point at the base and terminating distally in a dense mass of simple, unbranched flexuous thin tubes, the thecae.

Genotype. Medusaegraptus mirabilis *nov.*

Medusaegraptus while clearly belonging in the same group with Inocaulis, represents a separate development by lacking the frequent branching of the stipe, possessing a single stipe and terminating proximally into a tap rootlike basis, obviously for anchoring in the mud. The densely arranged filamentous appendages are marked by uniform width and abrupt extremities, indicating that they probably were tubular bodies and functioning as thecae for the zoöids. They are connected by pores with the interior of the thick stipes. The latter were filled with bundles of tubes, as in Inocaulis. In older colonial stocks the lower part of the stipe becomes smooth and much thickened, the filamentous thecae having been stripped off, probably after the death of the older zoöids of the colony. As the figures show, all stages between smooth stipes, such with short basal stubbles of the thecae and fully preserved long thecal tubes at the extremity of the colonial stock are seen. Plate 10, figure 4 represents the final old stage of the genotype; plate 8, figure 4 a similar condition in the smaller congener Medusaegraptus graminiformis (Pohlman). In M. graminiformis distinct evidence of a composition of the stipe of bundles of fibers as in Inocaulis has been seen.

The basal pores of the thecae are found only on the upper portion of the stipe, the lower being smooth and furnished with a thickened periderm. The pores are very closely arranged, in quincunx fashion, forming intersecting spiral lines.

The thecae, as seen in the genotype, are long tubes beginning narrow at the base but widening rapidly to a uniform width observed in all the appendages. Sections of the thecae in the rock leave no doubt that the tubes were hollow and thin walled, without any inner structures; the apertures round and straight transverse. We are, however, not at all sure that these long thecal tubes were not covered by still finer filaments or tubes. Suggestions of such a still finer set of appendages were noted in several places, at least in the genotype; as well as small pustules on weathered thecae, which may have been the attachment places of these further appendages.

Medusaegraptus graminiformis (Pohlman)

Plate 8, figures 1–4, pl. 13, figure 1

Chondrites graminiformis Pohlman. Bul. Buffalo. Soc. Nat. Sci., V. no. 1, 1886, p. 32.

Description. Rhabdosome consisting of long (4 or more cm). uniformly narrow (.6 to 1.2 mm wide) stipes, terminating at the base into a blunt point, distally into a small " head " with densely crowded, extremely delicate, unbranched filaments, probably the thecae. These are barely .1 mm wide and about 10 mm long. The basal pores of the thecae number five in the width of a stipe.

Horizon and locality. Bertie waterlime and Akron dolomite, Buffalo, N. Y.

Remarks. Doctor Pohlman described this form as a " marine plant " as follows:

> Chondrites graminiformis sp. nov. Fronds brittle, with few dichotomous branches in acute angle of divergence, all exactly linear by compression, more or less flexuous, generally broken in short fragments; surface covered with thin, smooth, coaly pellicle.
>
> These fragments are numerous and very distinctly traced in black upon the grayish-white and colored slabs, 1 to 1½ mm broad, mostly short, from ½ to 3 cm long, the longest fragment preserved being a curved branch 5 cm long. They are spread upon the stone in every direction and in such a way that the primary divisions of the frond can not be recognized. For all the fragments are simple, or with only a branchlet diverging in a very acute angle near the top of a few of them.

Pohlman did not figure his new species, but we have before us his type specimens (Buffalo Museum, 13312–1641), through the kindness of the director of the Buffalo Museum, William L. Bryant. These show that there is no dichotomy observable, and the apparent bifurcations are due to overlapping of stipes. While none of the stipes exhibits the " head " of filamentous thecae, a number of stipes in the middle of the slab bearing the types, show very distinctly, under the lens, the crowded stubbly bases of the filaments, all directed upward; exactly as in all stripped specimens of Inocaulis and Medusaegraptus. The filaments were so delicate that but very few specimens were observed exhibiting the " head " and the stipes apparently so brittle, that although the Buffalo Museum contains slabs (as $\frac{13272}{E1601}$) a square foot or more in size and densely covered with these fossils, only fragmentary stipes are seen, lacking the base and top and mostly reduced to a smooth flattened tube.

The specimen, reproduced in plate 6, figure 4 is the best that came under our observation.

Besides these mostly fragmentary larger stipes, there occurs in the Bertie waterlime a smaller form which we had originally separated as M. sedum taraxaci. The characters of these striking minute fossils (see plate 6, figures 2 and 3) are as follows:

Stipe mostly averaging 5–10 mm in length. Width quite uniformly .6 mm. Thecal tubes forming a small "head", only .05 mm wide, rather rigid, bristlelike, 6–10 mm long. Base acuminate.

These minute fossils occur always by themselves in multitudes on the surface of slabs, separated from the mature M. graminiformis. Since both forms, from their shape and the fact that numerous young individuals are still found upright in the mud (see plate 6, figure 3), must have grown anchored in the mud by their tap roots, it is hard to see how such a separation of assemblages of different growth-stage could have come about. It is, however, quite probable that the larger assembled specimens represent mature settlements that were overwhelmed by an inflow of mud, while the smaller ones are new settlements that were formed after such a catastrophe and failed to reach full growth before a new catastrophe intervened. The fact that practically all mature specimens of M. graminiformis are only broken fragments, lends support to the view that storms that reached the bottom and tore off the stipes and shifted the mud, were the principal cause of the destruction of the graptolite meadows.

The complete rhabdosomes of this graptolite must have reached considerable length, for the fragments do not show any increase in width and the rate of growth was obviously very slow, requiring a length of possibly a foot and more for the stipe to attain its full width. It would also seem that the stipes were not by any means as flexuous as the curvature of the fragments would suggest and were therefore apt to break into the multitude of fragments we find now scattered over the slabs.

The stubble of broken-off thecae observable on mature fragments of M. graminiformis, indicates that the theciferous portion often had a greater length than the "heads" would indicate.

This species is one of the commonest forms of the Bertie; a few specimens have also been found in the Akron dolomite, at Akron, N. Y.

Medusaegraptus mirabilis nov.

Plate 9, figures 1–6; plate 10, figures 1–4, plate 11, figure 1

Description. Rhabdosome large, attaining a length of 10 cm or more. Stipe straight or but slightly curved, sometimes bent hooklike at the base. Width of the stipe 2–3 mm. Thecae flexuous, attaining a length of 6 mm and 1–1.5 mm wide in the distal portions, but only .2 mm wide near the base. Basal pores of thecae a little longer than wide, about .2 mm wide, and about the same distance apart. A short ridge leads up to the slightly elevated rim from below. In old colonies the theciferous portion is reduced to a short "head," only about 10 mm long, while the stem is 10 times as long. The distal end of the stem is rounded.

Horizon and locality. Lockport limestone (Gasport lens), at Gasport, N. Y.

Remarks. This is by far the most striking of the graptolites of the Dendroidea, among the graptolites, found so far in the Silurian of New York, though far surpassed in size by associated species of Dictyonema.

The supposed thecae, long filiform tubes are bent in all specimens in such a way as to suggest a considerable degree of flexibility except in one where they are spread out as straight, radiating lines. This arrangement may, however, be also a result of the drifting of the filaments with the current.

Palaeodictyota buffaloensis nov.

This species is based on a single specimen from the Bertie waterlime at North Buffalo, N. Y. The rhabdosome, in the fossil condition, forms a subcircular patch about 75 mm in diameter. The meshes are irregularly polygonal to circular, for the most part, varying in diameter from 4 mm to 10 mm or more; the branches, on the average are about 1 mm wide.

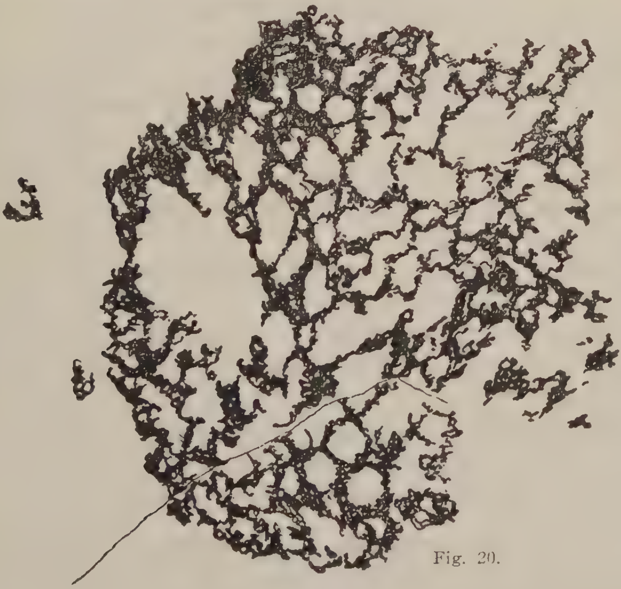

Fig. 20.

Figure 20 Palaeodictyota buffaloensis nov. Holotype. Natural size.

The thecal tubes and apertures have not been made out clearly enough to give their dimensions; indeed the specimen is so badly weathered that the only excuse for describing it is the interest that attaches to the occurrence of this genus of graptolites in the Bertie waterlime, the congeners only being known from the Clinton and Niagaran formations.

Diplospirograptus gen. nov.

(Διπλόος double, σπεῖρα coil, γρφειν to write)

Diagnosis. Rhabdosome consisting of tubular stipes which bear the theciferous branches. The first stipe bifurcates near the base, the resulting branches of the stipe are spirally coiled around each other; each branch doubly bifurcating again at long intervals.

Generic type. Diplospirograptus goldringae Rued.

Probably this genus represents an aberrant offshoot of the simpler genus Inocaulis with which it has the tubular stipes and more or less filamentous theciferous branchlets in common. Peculiar to this genus are the strange spiral coiling of the branches about each other, apparently for mutual support and the frequent bifurcations of the branchlets.[1]

Diplospirograptus goldringae nov.

Plate 7, figures 1–6

Description. Stipe doubly bifurcating 2 or 3 times, the resulting pairs of stipes each forming a close spiral. Whole rhabdosome 70+ mm long, the bifurcations about 20+ mm apart; the stipes about 1 mm wide; with theciferous branchlets 5–8 mm wide; the branchlets densely crowded, branching several times, about .2 mm wide, of uniform width.

Horizon and locality. Lockport limestone (Gasport lens), Gasport, N. Y.

Remarks. Although we have considerable material of this strange graptolite, it is mostly so completely flattened and the aspects of the stipes are so varying, that it proved a difficult matter to arrive at a final conclusion as to the structure of the form. Some slabs are covered with stipes that are stripped of the branchlets. Specimens as that reproduced in plate 7, figure 1, connect the cat-

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[1] The spiral axes, are, according to Professor O. Abel, who saw this graptolite, comparable to the spirally twisted stems of water plants, such as Potamogeton lucens or of certain species of Platycrinus and to be considered as a reaction of the colony to strong currents.

taillike complete branches (see plate 7, figure 4) with the stripped stipes. The latter mostly appear like a series of beads and it is mainly through specimens as that shown in plate 7, figure 2, where the two associated stipes have separated, that the spiral winding of the stipes is recognized. Numerous fragments (see text figure 21) show the spiral arrangement directly, when studied under water. A few, especially well-preserved fragments exhibit numerous pores, surrounded by raised rings, which we take to be the bases of the filamentous branchlets. The latter bifurcate several times; the segments are rather stiff in appearance, often slightly widening distally; the bifurcations are of such an appearance as to suggest budding of new thecae; the final terminations are abrupt and not threadlike tapering; the whole thus suggesting that the branchlets are composed of thecae, the segments between the bifurcations each representing one theca. The fundamental structure would then be similar to that of Inocaulis. No evidence, however, has been seen of a composition of the stipes of numerous fine parallel tubes, as in Inocaulis. It is, however, interesting to note that the bundles of fine tubes in Inocaulis are also spirally coiled within the stipes, and it is therefore possible that Diplospirograptus represents a branch of Inocaulis in which the inclosed bundles of tubes have become separated exteriorly, instead of remaining united under a common periderm.

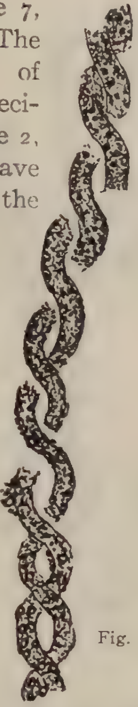

Fig. 21.

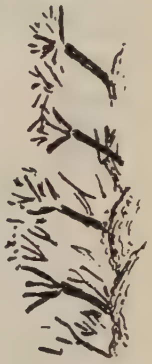

Fig. 22.

Figure 21 and 22 **Diplospirograptus goldringae** nov.
Figure 21 Enlargement (x6) of double spiral axes. Figure 22 Enlargement (x6) of theciferous branchlets.
Figures 21 and 22 are camera drawings.

The branchlets are arranged in double spiral series, as shown by the specimen reproduced in text figure 21: one series each on the outside of each of the stipes.

Thallograptus gen. nov.

(θαλλός a young branch, γράφειν to write)

The dendroid genera Dendrograptus and Inocaulis have been made the receptacles for a number of species which differ fundamentally

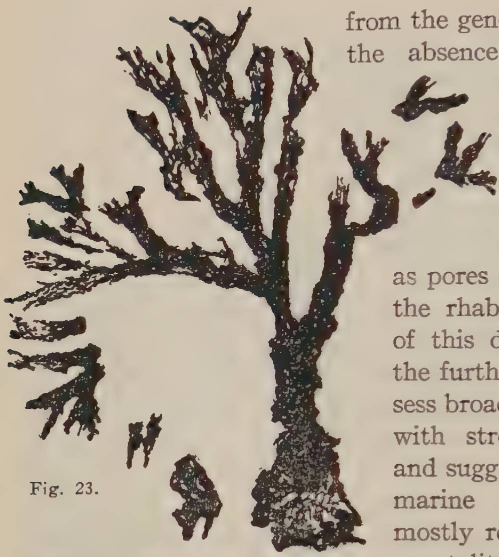

Fig. 23.

Figure 23 Thallograptus phycoides (Spencer).
Specimen from Rochester shale at Lockport, N. Y. Natural size.

from the genotypes of these genera in the absence of exterior projecting thecae, either in the forms of slender tubes or of shorter cuplike receptacles. In the species here to be segregated the thecal apertures appear as pores on the general surface of the rhabdosome. In recognition of this differential character and the further fact that they all possess broad or rather thick branches with strong carbonaceous films and suggest in their general habit marine algae, they have been mostly referred to the respective graptolite genera with doubt. The composition of the branches of chitinous tortuous tubes and the regularly arranged thecal apertures warrant, however, their placing with the graptolites.

We propose to unite these graptolites of vegetable habit and lacking the projecting thecae under the generic term, Thallograptus. Among others there will belong here:

Dendrograptus (?) succulentus *Rued.* (genotype).
D. dubius *Miller* (D. simplex *Spencer*).
D. frondosus *Spencer*
Inocaulis cervicornis *Spencer.*
I. phycoides *Spencer.*
I. (?) strictus *Spencer.*
I. vegetabilis *Gurley.*
I. ? thallosus *Gurley.*

It is the writer's intention to revise the genera of the Dendroidea in a forthcoming monograph of the graptolites of North America. At that occasion this genus will be more fully discussed.

Thallograptus phycoides (*Spencer*)

Inocaulis phycoides *Spencer.* Canadian Nat. X, 1882, p. 165 (nomen nudum); Trans. Acad. Sci. St Louis, IV, 1884, p. 565, 588, pl. 5, figs. 6, 7; Bul. Mus. Univ. State Missouri, I, 1884, p. 15, 38, pl. 5, figs. 6,7; Gurley, Jour. Geol. VI, 1896, p. 99, 309; Bassler, Bul. 65, U. S. Nat. Mus. 1909, p. 51–52, fig. 66; Bassler, U. S. Nat. Mus. 92, 1915, p. 666.

We have before us an excellently preserved specimen of this species from the Rochester shale at Lockport, N. Y. The species was hitherto known only from the Lockport limestone at Hamilton, Ontario.

The specimen exhibits in one part the interior fibrous structure. There are no marginal thecal projections and the apertures appear as minute pores on the finely lineated or smooth surface.

On account of the absence of the exterior projecting thecal tubes, seen in the genotype of Inocaulis, namely, I. plumulosus, this form can not be brought under the same generic group. The thecae appear here to have extended only as far as the general surface, where they had simple pores for apertures.

Climacograptus ultimus nov.

Plate 12, figures 3 and 4

Description. Rhabdosome minute; most specimens 3 mm long, a single one 5 mm long was observed; .5 mm wide, of uniform width. Thecae numbering about 23 in 10 mm (7 in a length of 3 mm). Apertures small, straight or slightly introverted. Outer margin straight or somewhat concave. Septum but little undulating, almost straight. Sicula and virgula unknown; virgella short.

Horizon and locality. Bertie waterlime at Buffalo, N. Y.

Remarks. We have but a single slab of Bertie waterlime with this fossil. This, however, is densely covered with the very minute graptolite stipes, in association with a large leg-spine of Eusarcus.

The principal interest of this insignificant fossil lies in the fact that it is found long after the graptolite genus Climacograptus has disappeared in our formations and supposedly was extinct. It is the first Climacograptus found in the Silurian of America. In Europe the genus is known to persist into the Silurian and the last of the British Climacograpti, namely, C. extremus H. Lapworth, from the Tarannon shales (base of Rhayader Pale Shales) is so similar to our form, that the two may prove vicarious species.

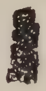

Fig. 24.

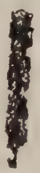

Fig. 25.

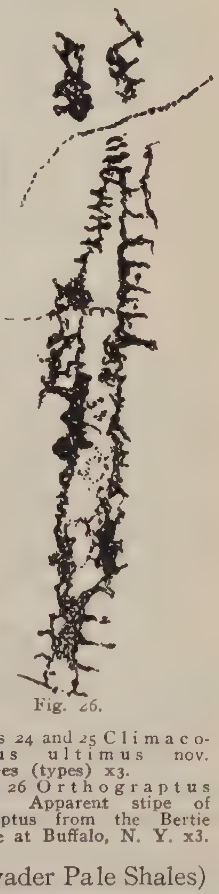

Fig. 26.

Figures 24 and 25 Climacograptus ultimus nov. Two stipes (types) x3.
Figure 26 Orthograptus (?) sp. Apparent stipe of Orthograptus from the Bertie waterlime at Buffalo, N. Y. x3.

The main difference seems to lie in the still smaller dimensions of our form and the less undulating septum, but our material is not so favorably preserved as to give certainty about this last character. The New York species occurring in the Bertie waterlime is still considerably younger than the British Tarannon form and therefore probably the last Climacograptus that has so far come under observation. It is an interesting instance of the long post-climacteric persistence of a genus in much reduced state, both as to number of species and size of individuals.

Orthograptus (?) sp.

Plate 12, figure 5

A single specimen of a large graptolite from the Bertie waterlime suggests the occurrence of a late species of Orthograptus or Glossograptus in the Middle Silurian. Unfortunately the fossil is too poorly preserved, being partly abraded, for positive determination. There is hardly any other feature observable, but the large square thecal apertures and sections besides patches of a firm continuous test. There is no trace of the reticulate structure as is seen in the Silurian Retiolitidae.

III ANTHOZOA

Ceratopora (?) sp.

Plate 15, figure 5

Some bedding planes of the Bertie waterlime at Buffalo contain remains of an organism, that, as is the case of so many fossils in the Bertie waterlime, have been nearly destroyed by the diagenetic processes accompanying and following sedimentation. A few specimens that luckily escaped destruction, as the one figured, show a distinct outline consisting of more or less bent, conical tubes that multiply by lateral budding. The form of the tubes and the mode of budding strongly suggest the coral genus Ceratopora Grabau (1899, p. 132). The specimen figured is partly preserved in section and this exhibits fairly strong calcareous walls and, in one place at least, a distinctly thickening of the walls by the formation of cysts which bear short, thick spines.

While the material is not sufficient to diagnose clearly the genus or describe the species, it serves to indicate the occurrence in the Bertie waterlime, of tabulate corals related to Ceratopora and it also serves to suggest the amount of destruction of fossils that has gone on in the Bertie waterlime.

IV HYDROZOA

Stromatopora sp.

Some irregular nodular projections in the Bertie waterlime, covered by a delicate carbonaceous film, could be recognized as the last remains of stromatoporas by the presence of astrorhizae, concentric lines along the margins and pores. The calcareous bodies (hydrophytons) have entirely disappeared and only the traces of carbonaceous matter have been left behind, preserving clearly, at least in patches, the original surface of the organism and near the margins concentric lines resulting from lateral views of the laminae, that were dissolved.

The fossils remind of S. galtensis (Dawson), as figured by Clarke and Ruedemann (1903, pl. 1, fig. 13) from the Guelph of New York. They are mainly interesting as attesting the presence of these hydrozoans in the Bertie sea and as showing the extent to which complete destruction by dissolution of calcareous shells and structures has been carried in the deposition and metamorphism of the Bertie waterlime.

V CYSTOIDEA

Pyrgocystis batheri nov.

Plate 13, figures 2–5

Description. Turret subcylindrical, about as high as wide; measuring about 5 mm in either direction. Turret-plates in eight columns of twelve plates. Each plate is shallowly concave, a little longer (about $\frac{1}{4}$) than wide and of broadly subelliptic to nearly circular shape with a straight or concave truncation at the base. The largest plates are 2–5 mm long; most measure about 2 mm or less. The amount exposed about one-fourth. The distal (basal) plates are nearly horizontal, smaller than the others, nearly circular in outline and not distinctly arranged in tiers. The plates are thick (.3 mm), smooth or of very finely granular surface; no spines have been observed. Oral face missing, the immediately surrounding plates smaller than the rest.

Measurements. The specimen, plate 13, figures 2–5, which is the only free one observed and is selected as the type, is apparently compressed vertically. It is 3.9 mm high on the longer convex side, 3.2 mm long on the opposite side; its greatest horizontal diameter is 6.5 mm; at a right angle to this it measures 4.5 mm in width.

Horizon and locality. Bertie waterlime, Bennett's quarries, North Buffalo, N. Y.

Remarks. The genus Pyrgocystis has been erected by Bather (1915, p. 49 ff) for an extremely interesting group of fossils that were first brought to light in the Silurian of Gotland and described by Aurivillius as cirripedes, being referred to the recent genus Scalpellum. Bather, noticing upon the edges of the plates in British material, the clean crystalline cleavage distinctive of calcite and of echinoderm stereom, recognized their echinoderm nature. In one British species, P. grayae, the oral face was found and this furnished the final proof of the cystid nature of this group of forms.

The relationships of Pyrgocystis have been fully discussed by Bather, who refers the genus for the present to the Edrioasteridae, in his excellent studies in Edrioasteroidea. Six species are described by Bather, one of these, P. sardesoni from the Lower Ordovician Decorah shale of Minnesota; another, P. grayae from the Upper Ordovician of the Girvan district in Scotland; one, P. ansticei from the Middle Silurian (Wenlock shale) of Shropshire, England: and three of Aurivillius' species (reduced from seven species originally distinguished by Aurivillius) from the Wenlock shale of Gotland. To this is added with our Bertie waterlime form, a seventh type from the Middle Silurian of New York.

We have altogether three specimens before us one, the type, entirely free, but apparently obliquely compressed; the two others close together on a small fragment of rock. These, while compressed laterally indicate the original straight cylindrical form of the turret.

VI VERMES

Protoscolex batheri nov.

Plate 14, figures 1 and 2

Diagnosis. Segments bear each two rows of papillae, of which thirty or more are visible on one side of the compressed fossil. Spaces between papillae equal or are less than the diameter of a papilla. Height of a segment about .7 mm. Width of a specimen about 4.3 mm. Ratio of segment height to width 16/100.

Horizon and locality. Lockport limestone (Gasport lens) at Gasport, N. Y.

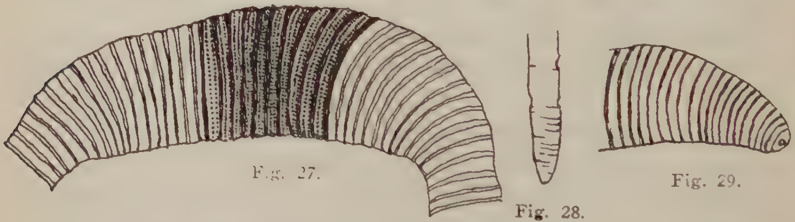
Fig. 27.

Fig. 28.

Fig. 29.

Figures 27–29 Protoscolex batheri nov.

Figure 27 Middle portion, showing clitellum and double rows of papillae on segments. x3.

Figure 28 Anterior end; fig. 29. Posterior end. x3.

Measurements. The holotype (plate 14 figure 1) measures about 118 mm in length: is 4.3 mm wide; and consists of 147+ (about 168) segments.

Remarks. The genus Protoscolex was erected by Ulrich (1878, p. 89) for four species of worms from the Eden series (Economy formation) near Covington, Ky. Later, Miller and Faber (1892, p. 83) added a fifth species from a lower horizon (the Fulton shale), and recently Bather (1920, p. 124) has elaborately described a congeneric form from the Lower Ludlow of Herefordshire, England, as P. latus. We have now before us a further species from the Silurian Lockport limestone near Gasport, N. Y. There are altogether three specimens, two fragmentary, and one complete with counterpart. The latter, the type of our species, is so well preserved that not only both extremities are clearly seen and the segmentation shown, but also the rows of papillae distinctly exhibited as whitish spots in several portions of the fossil. The segments are in some parts separated by deep furrows, of equal width with the papillae-bearing ridges, apparently the result of shrinking, for in other parts they appear only separated by sharp transversal lines. A shallower depressed transversal line passes between the two rows of papillae. The latter are for the most part of equal size, and the single papillae of the two rows as a rule are opposite each other, although in some parts they appear to be alternating. One end is sharply rounded. This retains the anus and is by the latter and the position of the supposed clitellum (see postea) marked as the posterior end. The other end is sharply drawn out, acutely pointed and that portion of the worm altogether narrower than the rest, the fossil thereby looking exactly like an earthworm that is moving.

Our species differs from its congeners by its greater absolute size and also relatively coarser structure, the segments being relatively higher; the ratio of segment height to width being twice that observed in P. latus Bather; while on the other hand, the papillae appear to be smaller and more closely arranged, there being eighty or more visible in our specimen in a width of 4–5 mm, against twenty in a width of 3 mm in the British specimen.

While P. latus exhibits as its most noteworthy feature a thickening of the median line regarded as the gut of a mud-eating worm by Bather, our most complete individual has a special interest of its own by retaining a swelling, suggesting the clitellum. This is shown in the greater width (6 mm, as against the 4.3 mm of the rest of the worm), attained abruptly in the space of two or three segments. Still more than by the width is the swollen part set off by the deep wide intersegmental furrows and the light gray color of the test, which in the remainder of the worm is dark brown, except the part directly in front of the clitellum which is also gray. The deep intersegmental furrows serve to give the aspect of an originally swollen condition and a later stronger shrinking to that part. The swollen part, which we consider as corresponding to the clitellum of the recent oligochaetes, is about 25 mm long and spreads over about thirty-eight segments.[1] There are more than forty-five segments in the shorter remainder of the worm, which we consider, on account of the location of the clitellum forward of the middle of the recent worm as the anterior portion.

The presence of a clitellum is also important for the taxonomic relations of Protoscolex. In discussing the probable systematic position of Protoscolex, Bather says:

> It is to the Oligochaeta that Protoscolex presents the strongest resemblance. The general shape, the close and undifferentiated annulation, and the long simple gut are all suggestive of that order. The apparent absence of a clitellum is by no means fatal, for that structure is very slightly developed in the primitive Moniligaster, and in most aquatic Oligochaeta appears only periodically. Therefore in Protoscolex it may not have reached such a stage of evolution to be discernible in the fossils, or the animals may have perished out of the breeding-season.

The holotype of P. batheri happily supplies this missing character and completes the chain of evidence supporting the reference of Protoscolex to the Oligochaeta.

If Protoscolex is an obligochaete, then there is no reason, as Bather shows, why it should not be referred to the Perichaetidae and the papillae should have carried setae. In that case we see in the fossil before us an ancestral representative of our earthworms which it so strikingly resembles. This might lead some of those who are strenuously seeking for evidence of land life in our Silurian rocks to consider these early Perichaetidae as land animals washed into the marine Lockport beds, but as Bather correctly says:

> It may be objected that the Oligochaeta, especially the group to which the Perichaetidae belong, are normally terrestrial, or, at most, inhabitants of fresh water. There is, however, *a priori* reason to suppose that terrestrial oligochaetes were derived from aquatic, and ultimately marine, forms.

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[1] It is true that the recent Oligochaeta have a smaller clitellum, comprising not more than eight segments, but it is to be considered that the swollen segments correspond to the size of the coccoon which they secrete and their number therefore was probably subjected in earlier times to considerable variation, with a tendency to a greater number in marine forms where larger broods are produced under the influence of a multitude of enemies.

And if those friends of mine who relegate the eurypterids into the rivers and their associates onto the land, persist too stubbornly, I shall meet them on common ground by urging that these Silurian angleworms obviously dropped from fishhooks where they had been carelessly fixed.

I am taking great pleasure in naming this important and interesting fossil species after Dr F. A. Bather, who has advanced our knowledge in nearly every branch of paleontology.

Bertiella obesa nov.

Plate 14, figures 3 and 4

The Bertie waterlime at Buffalo, N. Y., has afforded two specimens of a very plump " worm " that we have failed to connect with one of the few annelid genera so far described and that at the same time is so lacking in diagnostic characters that we can not place it with certainty in any of the classes of the Annulata and will describe it under the trivial and neutral term Bertiella obesa.

The larger specimen, which we select as the type, is about 118 mm long, measured on the outside of the curve; and 13 to 15 mm wide except the supposed foremost portion (10 mm long) which is 8 mm wide. The animal was therefore in a probably much contracted position, less than 10 times as long as wide. The anterior extremity is sharply rounded, the posterior one not fully preserved. The annulation, which has to be studied under water, is distinct in some parts, but owing to the violent bending of the fossil, quite irregular and indistinct in others and the number of segments can not be definitely determined. The segments appear flat or slightly convex in the middle, the constrictions are shallow. The segments were on the average about 1 mm wide (they are 1.5 mm wide on the outside of the curve and less than 1 mm on the inside), and numbered therefore more than a hundred. The surface of the segments is for the most part smooth, but in some parts are seen distinct circular nodes, a little narrower than the segments, to which in other parts of the fossil circular carbonaceous patches seem to correspond. There is in several places, especially near the front, an indication of a longitudinal serial arrangement of these nodes, about two series on the visible side.

At one extremity two converging, slender, subtriangular carbonaceous bodies are distinctly seen, that strongly suggest jaws. They are 2.5 mm long.

The smaller individual (cotype) is 45 mm long, 10-12 mm wide; abruptly rounded at both ends. One half shows very distinct segmentation, the segments being quite uniformly 1.5 mm wide; the other half appears smooth with but faint traces of segmentation. There are indications of papillae, but none of jaws.

From the manner in which the worm contracted himself, one can not help being reminded of the leeches. The absence of suckers and the form of the jaws, however, do not corroborate that suggestion. The size of the parapodia and the form of the jaws indicate a taxonomic position with the Chaetopoda; the absence of distinct setae makes also this relationship doubtful.

Dactylethra gen. nov.

(Δακτῠλήθρα, a finger-sheath)

Dactylethra conspicua nov.

Plate 15, figure 12

We propose to describe under the name given in the heading a problematical fossil from the Gasport lens of the Lockport limestone.

The fossil consists of black bodies of the shape of the fingers of a glove; rounded and closed at one end, hollow and more or less filled with sand in the middle and open at the other end. The closed end is in two specimens rather sharply bent sideways. The test appears to have had a leathery consistency, it is distinctly wrinkled in several specimens and slightly offset in another, while smooth and suggesting a firm tube in others. The open end shows a torn or irregular edge. The specimens range in length to about 10 cm as in the case of one kindly sent to us for inspection by Dr F. A. Bather, keeper of the British Museum. Our best specimen is 80 mm long, 19 mm wide and 3 mm thick in the middle. Smaller ones are 13 mm wide. The black carbonaceous film covering the fossil is smooth, without any traces of sculpture.

As these peculiar fossils are associated with the large graptolites of the Gasport lens notably Medusaegraptus mirabilis, which possesses similarly shaped though much smaller tap roots, the first impression was that these bodies might be the bases of very large dendroid graptolites. No graptolite stocks have been found, however, that would at all approach a size necessary for these large basal tubes.

Worm tubes and burrows of worms or other animals suggest themselves, but nearly all the specimens of Dactylethra we have seen lie on bedding planes, and all appear to have had a horizontal position. The wrinkled, carbonaceous, at one end sharply bent and compressed fossil indicates that the organism had a fairly firm test that was able to keep the tube open long enough to allow it to fill partially with sand.

The absence of marginal welts would not permit the fossil being placed with Serpulites.[1]

EXCREMENTA

Plate 14, figure 5

The bedding planes of some strata of the Bertie waterlime are densely covered with, or in some cases entirely composed of wormlike bodies. These have a uniform individual width, varying between 1 mm and 1.5 mm in the different specimens, and range in length, as a rule, from 10 mm to 20 mm. The extremities are rounded in complete specimens, in many, however, they are cut straight transversally.

While the fossils at first glance suggest a mass of worms, they fail to show any trace of segmentation or annulation, papillae etc. and are found on closer examination to be composed of flattened cylinders of sediment with enough organic matter to color them darker than the matrix. The only trace of sculpturing consists of faint longitudinal lines. Cross sections show sometimes a concentric structure.

There can be hardly any doubt that these bodies are either worm tubes or the excrementa of mud-eating animals, probably worms. Bertiella obesa here described would suggest itself, but it is not found associated with the excrementa and by the probable possession of jaws is shown to be a rapacious animal.

The fossils are of importance only in attesting to the abundant life in the Bertie sea.

VII BRYOZOA

Stigmatella sp

Like the stromatoporas and other calcareous structures, the bryozoans have left in the Bertie waterlime nothing but tenuous carbonaceous films. In one case such a film, about a square inch in size, finely retains the pores and acanthopores of a flat bryozoan zoarium, and these indicate a form belonging to or related to Stigmatella Ulrich and Bassler, a genus that is known from the Richmond and Clinton and may well have extended into the Bertie.

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[1] Professor O. Abel when shown our material, declared the fossils to be the ends of worm tubes. Similar forms occur in the Eocene and Cretaceous Flysch of the Wiener Wald in Austria and were exhibited at the 1923 meeting of the Paläontologische Gesellschaft, where R. Richter explained them as the posterior ends of worm tubes that extended horizontally or slantingly in the mud while the exit was by a vertical shaft. In the Eocene they possess a sericitic, glossy surface, resulting from a slimy effusion of the worms. To this latter may be also ascribed the dark film of our specimens.

VIII BRACHIOPODA

Orbiculoidea bertiensis nov.

The Bertie waterlime of New York has afforded four valves of Orbiculoideas, three from the outcrops about Buffalo and one from Sweet's quarry at Marcellus ("five feet above gypsum," D. D. Luther coll. 1899, Mus. loc. 2063).

All appear to belong to the same species, are of small size (the largest specimen measures 10 mm in diameter, the others about 6 mm), somewhat broader than long and flat. The pedicle slit extends from the subcentral apex to the margin and is rather wide. The brachial valve has the same outline as the pedicle valve, but may have been a little higher. Its apex is nearer by one-fourth of the centro-anterior distance to the anterior margin. The surface is marked by numerous strong concentric growth lines.

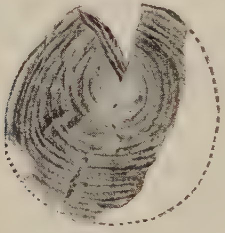

Fig. 30.

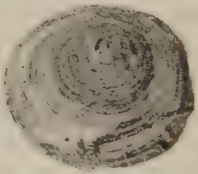

Fig. 31.

Figures 30 and 31 Orbiculoidea bertiensis nov.
Figure 30 Pedicle valve, x3. (Syntype).
Figure 31 Brachial valve, x3 (Syntype).
The original of figure 30 is from the Bertie waterlime at Buffalo; that of figure 31 from that of Sweets' quarry at Marcellus.

This species is very similar to the earlier O. molinensis Ruedemann of the Pittsford waterlime at Farmer's Mills (Ruedemann, 1916, p. 71), as may be expected with these indifferent forms. Its only difference, besides that of horizon, is the relatively greater width of the shell. Hall's O. vanuxemi (Hall 1859, p. 162) also recorded from the "waterlime group" is considerably larger and from the Manlius limestone.

Lingula lamellata Hall

Plate 15, figure 1

The Lockport limestone at Gasport has afforded half a dozen specimens of a medium-sized Lingula which in average size and outline are not sufficiently different from L. lamellata Hall (Hall, 1852, p. 249) to be separated from it, although the latter is thus far recorded only from the Rochester shale. The average width is 11 mm, the length varies from 13–16 mm; its dimensions agree thus very fully with those of L. lamellata; likewise the anterior and posterior outlines, while the sides are a little more convex and not subparallel as figured by Hall.

Several of the specimens before us retain distinct color markings. One of these, here reproduced, is so well preserved that the prismatic layer retains a nacreous lustre where the surface layer has peeled off near the beak. The color markings consist of broad, sharp concentric bands, running in strict parallelism with the growth lines. Their color is brownish-black, those near the anterior margin being black, while towards the beak they fade to a light brown, the intercalated bands showing the drab color of the rock.

In L. media the bands are likewise concentric and dark brown in color, while the intercalated space is light yellow to white; the bands are here relatively narrower and sharper than in the larger species.

Color markings on fossil brachiopod shells have long been known. R. Richter (1919, p. 84) cites nineteen species, adding another one in Newberria(?) granulosa Wedekind. To these twenty species are to be added the American forms described by Greger (six species, 1908, p. 313; 1914, p. 93) and Cleland (three species, 1911, plates 12 and 13). These are of especial interest to us, because among them we find linguloids. Cleland describes and figures color markings of Lingula milwaukensis Cleland (plate 12, figures 3 and 4), and Lingula sp. (plate 12, figure 5), both from the Wisconsin Devonian, as possessing dark concentric bands. To this Greger (1914, p. 94) adds another Lingula sp. from the Grassy Creek shale (Devonian) of Pike county, Missouri, that exhibits dark blue concentric bands, which were at first attributed to variation in the thickness of the shell, but were, after the shell had been carefully removed from the matrix, recognized to be true color bands. An Orbiculoidea humilis Hall, from the Hamilton shales of the Canandaigua lake region (Greger, *op. cit.* p. 94) also retains " alternating concentric bands of light greenish horn and dark chestnut brown "; and the Newberria(?) granulosa described by Richter possesses concentric dark bands. The remainder of the brachiopods exhibit either uniformly colored (Crania modesta, W. & St. J., Discinisca lugubris Conrad, see Greger) or irregularly spotted or, the most common case, radially striated or spotted surfaces.

Lingula subtrigona Ruedemann

L. subtrigona is a peculiar form of markedly great anterior width, which gives it a distinct subtriangular outline. It was described (Ruedemann, 1916, p. 69) as coming from the " Manlius limestone " on Frontenac island near Union Springs, N. Y. It is, however, now known that there is no Manlius limestone on Frontenac island and that the bed so formerly considered is of Bertie age. (" The waterlimes below horizon of blue limestone," D. D. Luther; the blue limestone being now correlated with the Cobleskill by C. A. Hartnagel).

Lingula testatrix Ruedemann

This species has been described (Ruedemann, 1916, p. 67) from the Bertie waterlime at Litchfield, N. Y., which is in Herkimer county, in the eastern part of the Bertie waterlime belt. It is distinguished from the other Salina species by its relatively large size and broad form; except L. subtrigona, which has a markedly different outline.

It occurs also, reaching the same size, abundantly in the Bertie waterlime at Cayuga Junction and Hills Branch, Cayuga county (loc. no. 2057, J. M. Clarke & D. D. Luther, coll. 1899); and east of the road from Union Springs to Cross Roads station (loc. no. 2359, D. D. Luther, coll. 1899).

Some of the specimens from Cayuga Junction retain beautifully the concentric color markings, as does also a specimen from the drift at Canandaigua (loc. no. 2950.)

Lingula media nov.

While the Bertie waterlime at Litchfield, Herkimer county, N. Y., in eastern New York, has afforded the relatively large and broad L. testatrix and the waterlime at Union Springs, Cayuga county, in the center of the State, the peculiar subtriangular L. subtrigona, the Bertie waterlime at Buffalo contains a small form that in relative dimensions and outline holds the exact middle between the earlier L. semina Ruedemann from the Pittsford shale and the Bertie form L. testatrix. This new type which may be distinguished as L. media is on the average 4 mm wide and 7 mm long. It is hence still smaller than L. semina and relatively wider, while on the other hand, it is relatively longer than the larger L. testatrix. The brachial valves are well rounded at both extremities as in L. testatrix, while the pedicle valves are less contracted at the posterior extremity. There is, however, a distinct variability in this form, which is so common on one bedding plane of the Bertie waterlime, that we counted on a slab of 9 square inches more than 200 specimens.

The phosphatic shells of this brachiopod are, in contrast to the mollusk shells, so well preserved as a rule in the Bertie waterlime, that the fine, relatively strong surface sculpture, consisting of concentric growth lines and also the color markings are preserved. The latter are more fully discussed under L. lamellata.

It is, however, an important observation for the understanding of the fauna of the Bertie waterlime, that while some blocks of Bertie waterlime are densely covered with the well-preserved shells of this pretty little Lingula, there have other blocks been found, where only vast numbers of delicate, elliptic carbonaceous shadows are seen with a black spot at one end. The aspect of these carbonaceous markings is so peculiar owing to the fairly sharp outline of the black spots that the writer was greatly mystified by them for some time until he could trace them through gradations into young Lingulas. In this case the phosphatic lime has been dissolved and only the organic matter been left, which is thicker at the beaks.

The carbonaceous films that remain of the younger Lingulas retain the subcircular black spot which occupies the place of the beak and may either mark the Paterina or Obolella stage of the shell, where the conch is still prevailingly corneous, or represent the base of the pedicle. Another interesting feature of these carbonaceous films is that many exhibit a distinct system of fine, crowded, wavy transversal lines. In one specimen of L. media, the corneous layer is preserved in a part of the shell, exhibiting the same system of delicate transverse lines. It is therefore probable that the transverse lines represent the structure of the corneous (chitin) layers of the shell in distinction to the concentric and radiating structure of the calcareous layers usually seen on the valves.

Similar transversal lines have been known for many years from the Clinton species L. lamellata Hall (=L. taeniola Hall & Clarke, see Hall 1852, pl. 20, fig. 4*a* and Hall and Clarke, 1892, pl. IV, fig. 8) and more recently been well figured of various Cambrian Atremata by Walcott (1912).[1]

Trematis spinosa nov.

Plate 15, figure 2

Description. Shell subelliptic in outline, 8 mm wide and 7.5 mm long; posterior margin wide, truncate, approaching a straight line. Brachial valve fairly convex, about one-quarter as high as long, sloping evenly from back forward. Beak small, elevated and projecting beyond the margin. Surface furnished with even, sharp, concentric lines, numbering 10–11 to 1 mm; surface rising towards the margin, into several higher rugae. Between the lines are fine punctae separated by more or less straight lines, transverse to the concentric lines. There are about twelve of these punctae to 1 mm. Toward the margin the porose surface is seen to be covered by a darker epithecal layer which extends into mucros and along the margins into spines, about 1 mm long.

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[1] See f. i. Obolella (Westonia) blackwelderi *op. cit.* pl. 39 figure 10.

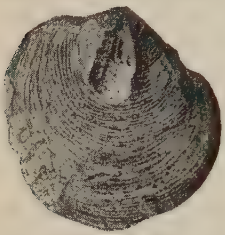

Fig. 32.

Figure 32 Trematis spinosa nov. Pedicle valve x3. (Paratype).

~~Pedicle valve not known~~.

Horizon and locality. Lockport limestone at Gasport, N. Y., in association with Inocaulis plumulosus and other dendroid graptolites.

Remarks. The genus Trematis ranges in North America from the Trenton into the Richmond and may therefore be expected to go still higher in the Silurian, as it apparently does in Great Britain.

The Lockport species is readily distinguished from the congeners by the elliptic outline, the nearly straight posterior margin, the character of the punctae and the marginal spines. Not having seen the pedicle valve, our reference of the form, of which we have two specimens before us, to the genus Trematis, is mainly based on the characteristic surface sculpture. It would seem that the porous layer was originally entirely covered by the spinose conchiolinous epithecal layer.

Camarotoechia cf. **andrewsi** Prouty

A slab of Bertie waterlime at North Buffalo was found to be covered with fragmentary impressions of a middle-sized Camarotoechia. While the material is not favorably preserved for a conclusive determination, it is apparent that the species in outline, character and number of plications on the valve and in the sinus, best agrees with Camarotoechia andrewsi, a form described from the McKenzie formation of Maryland by Prouty (1923, p. 439).

Spirifer (Delthyris) eriensis Grabau

Plate 15, figures 3 and 4

Spirifer eriensis was described by Grabau (1900, p. 366) from the Cobleskill ("Bullhead") limestone of North Buffalo. It has since been recognized also in the Rondout limestone of the neighborhood of Buffalo and in the Helderbergian (Keyser) of Maryland, New Jersey and New York (see Bassler, 1915, p. 1174).

The form is thus well established above the Bertie waterlime. Two specimens which Mr Reinhard has collected in characteristic Bertie waterlime of North Buffalo indicate that this species already existed before Cobleskill time. One of the specimens is very small (5 mm), the other, however, has the size of an average S. eriensis.

IX LAMELLIBRANCHIATA

Ctenodonta salinensis Ruedemann

Under this heading the writer (1916, p. 75) has described the only fossil so far known from the Salina beds. The type specimens came from the Camillus shale at Bull's quarry, town of Lenox, Madison county. A slab from the same locality is figured here (plate 3, figure 1) that was later found in the State Museum and which contains the little shells on the same surface with large "hopper-crystals", and with small worm tubes and trails. It would seem impossible that these lamellibranchs could have existed in the same water in which the large skeletons of salt crystals formed, and it must be assumed that on the mud flats of the Salina sea great local variations in the saltness of the water were found and rapid changes took place with varying influx of new water and evaporation.

Professor Harold L. Alling of Rochester has recently sent on representatives of this species which he collected at the gypsum locality at Garbutt, Monroe county, N. Y. They are also from the Camillus shale and occur on slabs with small worm tubes, trails and other evidence of a precarious organic life in that part of the Salina sea.

Rhytimya buffaloensis nov.

Plate 15, figures 6 and 7

Description. Shell small, compressed-convex, elongate, the length twice the height. Beaks small, little prominent, about one-third the length behind the anterior extremity; umbonal ridges and mesial sulcus very inconspicuous. Cardinal margin about five-eighths of length of shell, straight posterior to the beaks, declining fairly strong anterior to them; anterior end wide, sharply rounded above, uniformly curved in the middle and below; ventral margin, little convex, almost straight; posterior margin oblique, strongly rounded in the lower half; postcardinal extremity obtusely angular. Surface with irregularly alternating stronger and weaker concentric folds; in front of the beaks all folds thick and prominent. No radiating striae observed on the posterior slope.

Dimensions. The type specimen is 12 mm long and 6 mm high: the cotype is 7.5 mm long and 4.5 mm high.

Horizon and locality. Bertie waterlime, North Buffalo, N. Y.

Remarks. We have only two specimens of this species, both of which are broken at the beak. Together, however, they furnish a fairly complete set of data; and considering the scarcity of fossils other than eurypterids in the Bertie waterlime, we have ventured to describe the species. In outline as well as in the strong development of the concentric folds in front the form is a Rhytimya, and we have placed it with that genus although it lacks the radiating lines of the posterior portion and Rhytimya has so far not been reported from the Silurian above the Richmond.

Goniophora sp.

Doctor O'Connell (1916, p. 87) has cited Goniophora sp. as the representative of the pelecypods in the Bertie waterlime. This citation is corroborated by a small specimen in our collection, that exhibits the outline and sharp posterior ridge of a Goniophora. It is, however, too fragmentary to be described.

X GASTROPODA

Hercynella buffaloensis O'Connell

Plate 15, figures 8 and 9

Doctor O'Connell (1914, p. 93) has described two patelloid gastropods from the Bertie waterlime at Buffalo as Hercynella buffaloensis and H. patelliformis. Neither of the types of the two species is perfect, the apex being missing in all specimens.

We have before us a specimen of the smaller form, H. buffaloensis that retains the apex. The latter is situated one-fourth of the diameter from the anterior margin, rather prominent, the shell being one-third as high as long (10 mm high, 28 mm long). The shorter (frontal) slope is convex, becoming nearly vertical near the margin, the opposite slope is gently concave.

The two species are referred to the Bohemian genus because of the presence of a small sinus on the margin and a corresponding reentrant on the growth lines suggesting a structure similar to the fold characteristic of the genus Hercynella. Doctor O'Connell is aware that the American forms lack the characteristic development of the flexure of the Bohemian types and explains this with the earlier appearance and more primitive condition of the American species, proposing the term " Hercynellina " in case the latter should prove different with the discovery of more and better material in the future.

Our specimen shows but the faintest suggestion of a marginal sinus and reentrant in the growth lines and not any of a flexure. We should have placed the form with Palaeacmaea, especially since it lacks the radiating lines[1] of Hercynella, while exhibiting strong growth lines, but consider it possible that the weak sinus and reentrants will prove such a constant character as to require recognition, together with the slightly asymmetric position of the apex, another character present in much more emphasized condition is Hercynella.

The main interest in our specimen centers in its preservation. Like O'Connell's types in the Buffalo Museum, the shell is preserved as a mere carbonaceous film. This observation has led Doctor O'Connell to the conclusion that the creatures had extremely thin shells, which conclusion again is used to infer, by contrast with the thick shells of the marine Bohemian congeners, a fresh water habitat for the Buffalo Hercynellas. This conclusion, so much desired by the author of the paper, because of their association with the eurypterids, is, however, clearly erroneous. The Hercynellas of the Bertie waterlime had undoubtedly very thick shells, for the following reasons. The thin film is no evidence whatever of a thin shell, because in the same bed occur the numerous specimens of Pristeroceras here described, a Hexameroceras type whose shell was distinctly specialized for protection and is always thick in the Bohemian and our Niagaran rocks. These originally thick shells are also preserved as mere films, since as in the related gastropods the aragonite composing them was easily dissolved. Also Trochoceras and Orthoceras shells are reduced to films, and even Stromatoporas appear as hardly noticeable films, but are still recognizable by the astrorhizae. Nor is the suggested inference (*ibid*, p. 96) that the Hercynellas had entirely corneous (conchiolinous) shells admissible, for such are also better preserved as is shown in the case of the eurypterids.

Another character that disagrees with the supposed original thinness of the shells is the distinct presence of concentric rugae or thick growth lines even in the thin film, suggestive of a former thick shell. Still more is this latter indicated by the very small amount or entire absence of vertical compression in the shells, as clearly shown in our specimen, and which contrasts even with the greater compression of the thick Prionoceras shells and still more with those of the flattened-out eurypterid-skins.

Doctor O'Connell's suggestion that the shells appear, as " though available lime were not abundant in the water in which they lived " is in direct contradiction to that other statement of the same author, that the Bertie waterlime was formed by rivers that carried an abundance of lime (O'Connell, 1916, p. 112, 117.) And to make the circle of erroneous conclusions complete fresh water shells are by no means always thin, for, as the thick-shelled mussels of the Mississippi basin show, the mollusks are perfectly able and willing to make the most of the lime in the river waters (Coker, 1919, p. 15)[1], and of course would have done so with especial satisfaction in that highly limey hypothetical "Bertie river" that carried the eurypterids and deposited the Bertie waterlime.

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[1] Doctor O'Connell describes traces of such from the type of P. buffaloensis.

Loxonema (?) **bertiense** nov.

Plate 15, figure 10.

The Buffalo Museum (No. $\frac{15710}{E2828}$) contains a single specimen[2] of a medium-sized gastropod, from the Bertie waterlime at Buffalo, collected by Mr E. Reinhard. It is much flattened and its substance in the upper portion reduced to a mere film, leaving much doubt as to its generic relations. Owing to the apparent absence of a slit-band, or of its impression, and the oblique shape of the volutions, we refer the form to Loxonema, which already contains similar species from underlying and from younger formations. Grabau (1910, pl. 32, fig. 5) has figured as Loxonema (?) sp. a fragment of a still larger, but otherwise similar form from the Akron dolomite at Akron, N. Y.

The characters of the specimen are as follows: Shell of medium size (length 31+ mm, width 7.5 mm), seven volutions shown. Volutions loosely turreted with very deeply impressed sutures; strongly convex in the younger part, more angular in last volution (through imperfection of preservation ?). Angle of spire about 15 degrees, fairly regular. There are no traces of sculpturing seen.

It is possible that better material would give evidence of a slit-band and of characters bringing the form under Lophospira, which, for example, contains in L. subulatum (Conrad) of the Clinton of New York a type of quite similar slender spire with oblique volutions.

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[1] This paper contrasts the mussel shells of the Atlantic region with those of the Mississippi basin and points out the dependence of the thickness and compactness of the shells (suitable for the button industry) on the lime content of the river water.

[2] Meanwhile another specimen has come to hand that exhibits the same characters.

Hormotoma gregaria Ruedemann

When we (1916, p. 73) described this species, we had only specimens from the lower Bertie waterlime at Marcellus, N. Y., before us. Meanwhile the form has also been obtained in the Bertie waterlime at Buffalo and at Litchfield, Herkimer county. It is there mostly preserved as fine black films only, with low wavy elevations indicating the volutions. One specimen from Buffalo, 10 mm long, consists of nine volutions. The specimens from Litchfield, are smaller, only one-half the size of the others and have grown only to four volutions. They appear to be only the young, or a stunted variation of the species.

XI CEPHALOPODA

Orthoceras sp.

Plate 16, figure 3.

Besides the large Dawsonoceras oconnellae the Bertie waterlime at Buffalo has afforded a second orthoconic cephalopod that was collected by Mr Reinhard. The specimen is here figured. It shows little more than a slowly tapering conch with a narrow, central tubular siphuncle. The septum shown at the end of the conch is quite convex.

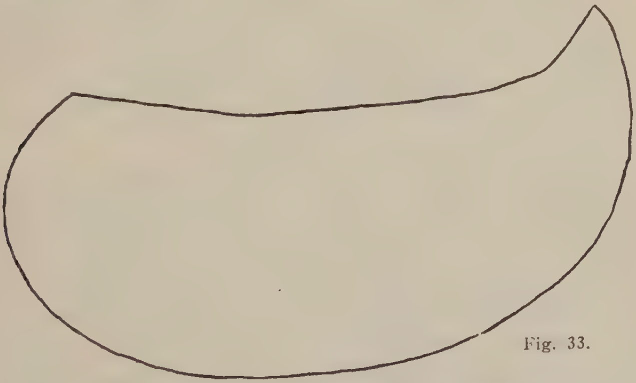

Fig. 33.

Figure 33 Outline of living chamber (or distorted septum) of a large unknown cephalopod. Natural size. Bertie waterlime. North Buffalo, N. Y.

The most interesting ture of the specimen is the light brown longitudinal lines, 1 mm wide, separated by wider intervals, similar to the color bands described by Blake of Orthoceras annulatum Hall and by Foerste of Orthoceras trusitum Clarke and Ruedemann (see Ruedemann, 1919, p. 80, 81.). Like the longitudinal color bands of Geisonoceras tenuitextum (Hall) (*ibid*, p. 82) they seem to become thinner towards the sides and may have been absent on the opposite (ventral) side altogether.

Dawsonoceras oconnellae nov.

Plate 16, figure 2.

The Buffalo Museum contains a large orthocone from the Bertie waterlime of the Bennet quarries in North Buffalo (No. $\frac{11462}{\text{E977}}$ of collection) that has been cited as Orthoceras undulatum Hall by Doctor O'Connell (1916, p. 87).

Orthoceras undulatum Hall is a form of the Rochester shale and Lockport limestone that belongs to the group of Dawsonoceras annulatum (Sowerby). Foord (1888, p. 57) has erected for it the var. americanum of D. annulatum. Bassler (1915, p. 388) cites O. undulatum as a synonym of D. annulatum. Whatever the relations of D. undulatum to D. annulatum may be, it is certain that the Buffalo specimen does not belong to either, although it seems to have possessed the undulate surface ornamentation of the Rochester shale fossil. Its rate of growth is considerably more rapid than that of either D. annulatum or D. undulatum. It is about 1 in 7, while that of annulatum is given by Foord (*ibid*, p. 53) as varying from 1 in 10 to 1 in 14 and that of undulatum as 1 in 17 (*ibid*, p. 57). Hall's figures of D. undulatum corroborate this statement. Furthermore, the siphuncle is not central but submarginal in position.

The specimen is a large orthocone, 22 cm long and expanding from a width of 22 mm to 55 mm. The siphuncle is tubular and has a width of 9 mm where the conch is 22 mm wide. It is about 2 mm from the nearest margin. The living chamber was relatively large; it occupies 111 mm in the specimen. The septa were shallow; the depth of the camerae was about one-fifth of the width of the conch (8 mm where the conch is 40 mm wide). The ornamentation apparently consisted on the living chamber of transversal frills such as are seen in D. undulatum; in the earlier part also traces of transverse ribs are observable.

Phragmoceras accola Ruedemann

This large cephalopod from the Bertie waterlime at Litchfield has been fully described before (Ruedemann, 1916, p. 77). Four specimens were figured. Three more have since come to hand from the same locality, which, although fragmentary, suggest the same species.

Trochoceras cf. **anderdonense** Grabau

Plate 17, figure 2.

Trochoceras anderdonense Grabau. Michigan Geol. & Biolog. Survey. Publ. 2. Geol. Series 1, 1910, p. 200, pl. 28, fig. 9, pl. 29, fig. 5, 6.

Mr Reinhard has collected in the Bertie waterlime two coiled cephalopod shells that are too poorly preserved to allow positive determination. So much, however, is certain that they are forms with more widely open umbilicus than Mitroceras gebhardi has, that their volutions were rounded and slowly increasing in size. In all these characters, as well as in their dimensions the specimens agree with T. anderdonense Grabau, a form obtained in the Amherstburg bed of the Monroe formation in the Detroit River in Michigan. According to Grabau's correlation the Amherstburg dolomite and Anderdon limestone correspond to the Cobleskill limestone and Bertie waterlime, so that there is also identity of relative ages.

The second specimen exhibits what appears to be a fragment of a slightly nummuloidal siphuncle on the inner, lower side of a volution.

Pristeroceras timidum gen. nov. et. spec. nov.

Plate 14, figures 1–7.

Description. Conch a medium-sized arcuate brevicone; section of living chamber broadly oval, widest about one-third the median section from the dorsal margin; the median axis about one-fifth longer than the transversal. Siphuncle marginal, tubular, probably ventral.

Final living chamber large and subglobose, occupying one-half of length of conch, curved more on the dorsal side, the strongest curvature being found in the lower third; ventral margin more evenly curved. Aperture in plane sloping distinctly from dorsal to ventral margin. Lateral sinuses of brachial area six in number, very unequal in size, the first very shallow, extending in dorsal direction, the second longest, curved dorsally, the third short and broad, extending obliquely in ventral direction. Hyponomic area consisting of long, narrow slit, the edges of which are provided with distinct serrations, about five on each side, which alternate or interlock; and an oval ventral opening the edges of which form a distinctly projecting spout.

The camerate portion is rapidly contracting and more or less curved toward the ventral side. Camerae very shallow, about 9 times as wide as deep (estimated). Sutures fairly straight transverse. Septa shallow, their depth about equaling that of camerae. Surface sculpture consisting of growth-lines only.

Measurements. The living chamber of an average specimen (fig. 7) is 33 mm wide in dorso-ventral direction and 35 mm long. The aperture measures 27 mm long, and the base 25 mm in dorso-ventral direction. The length of one specimen (fig. 5) not complete at the apex is 53 mm (living chamber 32 mm); it probably was about 8 mm longer.

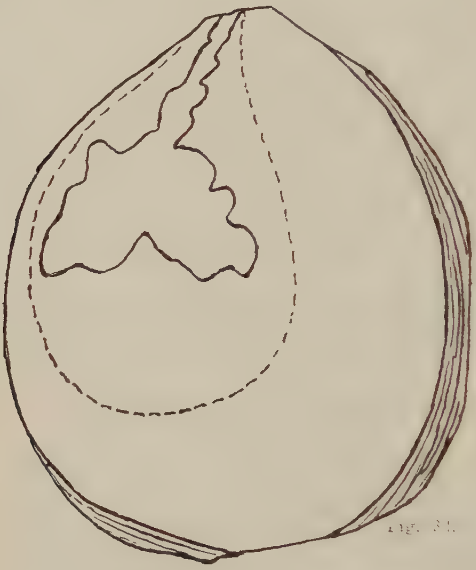

Fig. 34.

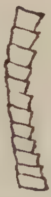

Fig. 37.

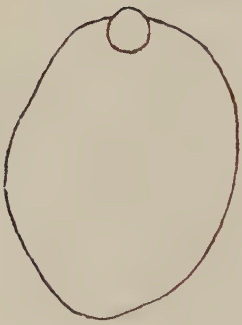

Fig. 35.

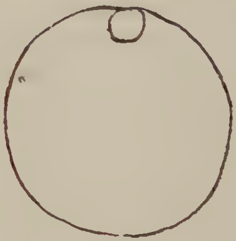

Fig. 36.

Figures 34–37 Pristeroceras timidum nov.

Figure 34 Large specimen obliquely compressed, seen from apertural side, showing aperture and basal outline of living chamber. Natural size. Original in the Buffalo Museum.

Figures 35 and 36 Upper and lower septa with marginal siphuncle, referred to this species. Natural size.

Figure 37 A detached siphuncle, found in the Bertie waterlime and referred to this species.

Horizon and locality. Bertie waterlime, Buffalo, N. Y.

Remarks. The fossil before us invites our interest for various reasons, first as a new representative of the short-lived group of breviconic forms with strongly contracted apertures; then as a cephalopod occurring in the Bertie waterlime where but few other fossils but eurypterids have been obtained; and finally, and this is its most interesting feature, for exhibiting series of teeth in the slit leading to the hyponomic sinus.

We have already (Ruedemann, 1916, p. 80) pointed to the restricted range of the entire group of Trimeroceratidae which in Bohemia occur only in the Middle Silurian and in America in the Niagaran. To the four species of Hexameroceras known before from the Niagaran of Ohio and Indiana, we had there added a species from the Guelph of New York, and one from the Pittsford shale (as Septameroceras (?) sp., probably also a Hexameroceras); and a small Gomphoceras from the Bertie waterlime at Morganville, N. Y.[1]

In a later paper (Ruedemann, 1919), a further species of Hexameroceras was described from the Vernon shale at Pittsford. To this is added now a further form of Hexameroceras from the Bertie waterlime which, however, in the serrate condition of the hyponomic slit presents an important character that sets it off as a still more aberrant type which it is proposed to recognize by the generic term **Pristeroceras**. (Πριστήρ, a saw).

The biologic importance of this character consists in its falling completely in line with the views advanced lately by Prell (see H. Prell, 1921, p. 303; also Ruedemann, 1922, p. 56), on the mode of life of the breviconic cephalopods with contracted apertures. These strongly contracted, more or less lobed and sinuous apertures have been variously, but never satisfactorily explained; the general assumption being that the lobes were the exits of arms and thereby indicative of the number of arms. Professor Prell shows the impossibility of the animals effectively extending arms through the often very narrow slits or if they ever could do so, of bringing any prey to the mouth within the shell. He further shows that the gradual contraction of the aperture which is entirely a feature of maturity and old age finds its exact analogy in certain forms of Helix and such marine gastropods as Cypraea. In these, however, the body of the animal is so plastic during life that it can be readily and wholly extruded with foot and mantle through the narrow slit, a feat which seems impossible to one who is only accustomed to see the hardened bodies preserved in alcohol. By comparison with these forms it is concluded that the animals of Phragmoceras (in its older wider sense) also were plastic enough and lacked all cartilaginous cephalic parts, so that they could extrude their entire cephalopodium. They could then easily move, either crawling or swimming, capture and devour prey, and retreat completely for protection within the shell. The apertures of the mature individuals became undoubtedly contracted for protection as in the gastropods mentioned above. It is now a final step, exactly along the development seen in Helix and Cypraea, that interlocking teeth develop when the slit has reached its limit of contraction and the form is still seeking further protection by narrowing the aperture.

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[1] The latter (G. osculum Ruedemann) is cited there as occurring in the Cobleskill limestone. According to recent information from Professor G. H. Chadwick the bed is his Falkirk dolomite.

Abel (1920, 1924, p. 193) has advanced the alternative hypothesis that the forms with constricted apertures were feeding on microscopic organisms. Such microphagous forms would have no need to thrust out the head and would also, as the recent Dibranchiata using microscopic food, suffer reduction of the fleshy arms.

It is probable that both adaptations, that to extrudibility of the entire cephalopodium and that to microscopic food, may be represented in the various forms with constricted apertures, the latter varying widely between the Hexameroceras and Phragmoceras types. It seems natural that the little offensive microphagous forms would not only need the protection of the constricted apertures, but also the wide expansion of their grasping or, rather, food-inducting organs, made possible by the extrusion of the cephalopodium.

The complete absence of rhyncholites in association with these older cephalopods throws doubt on the supposition that they were such ruthless robbers as many of the recent Dibranchiata and Nautili are.

It is also significant that Pristeroceras timidum occurring in the Bertie is the last representative of the whole family; at least, on this side of the Atlantic. We must therefore infer that the group became either extinct by protective measures carried too far, or else as Steinmann believes, by throwing off their shells altogether, or rather incorporating them completely in the body and finally resorbing them, succeeded in leading to the more recent shell-less cephalopods.

Finally, also the stratigraphic occurrence of this species is interesting enough to be briefly noted. The species occurs in the Bertie waterlime which on account of its eurypterid fauna has been in late years the object of considerable speculation as to its bionomic conditions. We will recur to this question in another chapter when all new facts are available, and here only state that we have before us remains of about twenty individuals — all from a restricted locality — or too many to consider the occurrence as that of a straggler only, carried out of his marine realm into the upper reaches of a delta.

The specimens here described are all preserved as mere carbonaceous films, as are all cephalopod and gastropod shells, the aragonite of the conchs having been completely dissolved in the Bertie waterlime beds. The specimens represented in figures 4–7 are moreover so completely flattened that the original section could not be made out from them and has to be inferred from the vertically compressed specimens (text figure 34), and from the septa (text figures 35, 36) whose reference to Pristeroceras timidum, however, is not beyond doubt. Notwithstanding the fragile preservation of the specimens, their general shape, the strong impressions of growth lines and the condition of their known relatives in other localities, all indicate that they were originally furnished with thick-walled, compact shells.

Mitroceras Hyatt

Hall (1852, p. 335) proposed the generic term Trochoceras for two species of cephalopods of the Coralline limestone (now Cobleskill limestone) of Schoharie, N. Y., namely, T. gebhardi and T. turbinatum. The name was preoccupied, for Barrande had already erected a genus Trochoceras in 1848, but both authors "courteously acknowledged each other," as Hyatt (1894, p. 503) states, and henceforth called the genus Trochoceras, Barrande and Hall. Nevertheless it is obvious that the Bohemian and American forms united by these authors are not congeneric, and Hyatt has therefore distinguished the two American types as Mitroceras, with M. gebhardi as genotype.

The types of both species, M. gebhardi and M. turbinatum (holotype in the case of the second species) are preserved in the New York State Museum together with a number of additional specimens.

A study of this material shows readily that the two species can not be congeneric, for one has a low trochiform outline (M. gebhardi, see text figure 38), while the other has a high turbinate one (M. turbinatum) and likewise the sections of the volutions differ. Hall recognized this difference between the two in defining his genus as being "turbinate or trochiform" adding that the "spire is elevated, more or less ventricose" and Hyatt's name Mitroceras must have been given under the impression that the genotype *gebhardi* had also a high mitriform shape such as turbinatum has.

Bassler in the Bibliographic Index (1915, vol. 2, p. 1297) has, in recognition of the difference between the two species, retained turbinatum under Trochoceras. A comparison with Barrande's genotype of Trochoceras (T. davidsoni) shows, however, the wide difference between the high, adjoining volutions of turbinatum and the subcircular, free volutions of davidsoni.

Both American forms are remarkable fossils of unique shape. They represent a development of the torticone to a degree not known in any other Paleozoic formation, and only duplicated, by later parallelism, in the torticones and turriliticones of the Cretaceous ammonites. It is an aberrant attempt of the early nautiloids to a contraction of the shell into a narrower space by coiling in a close spiral curve and this contraction is carried so far that a distinct impressed zone and sharp angulation of the upper and lower margins of the volutions result in gebhardi.

The genus represented by the single species turbinatum and differing from Mitroceras, as known in M. gebhardi, in the much higher elevation and development of the spire we propose to name "Foersteoceras," embracing this occasion with pleasure to connect the name of one of the most untiring students of the Silurian stratigraphy and paleontology of North America with this unique and interesting form.

Hyatt did not define his genus Mitroceras, except by stating that the two Cobleskill forms are quite distinct from Barrande's Trochoceras and designating Trochoceras gebhardi as the genotype.

Mitroceras, as here restricted, is characterized by trochiform spiral volutions forming a low torticone whose volutions are in section about as wide as high, semicircular on the outside and subquadrangular on the inside, with sharp angles on the under and upper sides. The upper inner side which is in contact with the next volution is flat. The location of the hyponomic sinus cannot be directly observed as the growth lines are poorly preserved, but it is fairly safe to assume that the shell was carried with the volutions standing upright, in which case the hyponomic sinus and funnel were on the outer margin. Nor can the location of the siphuncle be directly observed, owing to the destruction of the inner structure. The sharp bending backward of the sutures on the outer angle indicates a ventral location (on the outside in this case) of the siphuncle, and a trace of a siphuncle on the outer side of the second (upper) volution in the type specimen agrees with this inference.

Foersteoceras possesses a high mitriform or turbinate torticone, whose volutions are higher than wide, rounded both on the ventral (exterior) and dorsal (inner side) and possessing but a slight angulation along the upper side.

Both Mitroceras and Foersteoceras are similar in their general structure, notably the torticone mode of volution and clearly represent a development in the same direction, in which Mitroceras has gone a step farther than Foersteoceras, in the consolidation of the volutions to such a degree that a distinct impressed zone and bounding keels are formed. It is obvious that this aberrant development took place in response to some peculiar adaptation of the form. The Cobleskill limestone in the Schoharie region is a distinct coral reef formation, in some places the beds being entirely composed of large colonies of Favosites, Prismatophyllum and Stromatopora. It is therefore legitimate to consider the two cephalopods as members of a coral reef fauna. They are associated with species of Phragmoceras, Oncoceras and thick-shelled Murchisonias, which likewise suggest life on a coral reef. It is probable that these solid, contracted cephalopod shells were better able to move about between the coral stocks and to retain their hold in the turbulent waters.

Mitroceras gebhardi (Hall).

Plate 19, figure 2.

Description. Conch a low, trochiform dextral torticone, (apical angle about 155°, conjectural) about twice as wide as high. Four to five volutions, which increase about two-fifths of their diameter in one whorl, are subquadratic in section, the outer side being rounded, the inner lower side gently convex, the upper gently concave; the margins between the inner and outer sides distinctly angular or slightly keeled, the inner angle less acute. Volutions in contact only with the middle of the lower exterior, respectively inner upper sides, forming a wide umbilicus between them.

Living chamber large, occupying one whorl or more. Aperture unknown. Septa closely arranged, sutures strongly curved, with broad, low, external saddle and narrow, angular saddles on the keels, with broad, flat lobes on the two inner sides.

Siphuncle incompletely known, apparently small, slightly nummuloidal, submarginal on middle of outer (ventral) side. Surface furnished with growth lines and some deeper constrictions. Hyponomic sinus shallow, on exterior side of volution (exogastric form).

Measurements. The type specimen (plate 20, figure 1) no. 12566 ——— of Museum catalog, measures 115 mm across the base; the height of the two last volutions is about 48 mm; the entire height was about 60 mm. The greatest width of the last volution, which is not perfect, is 38 mm and the height 38 mm (probably originally slightly more). The sutures on the penultimate whorl are 3 mm apart, the siphuncle is there 2.5 mm wide.

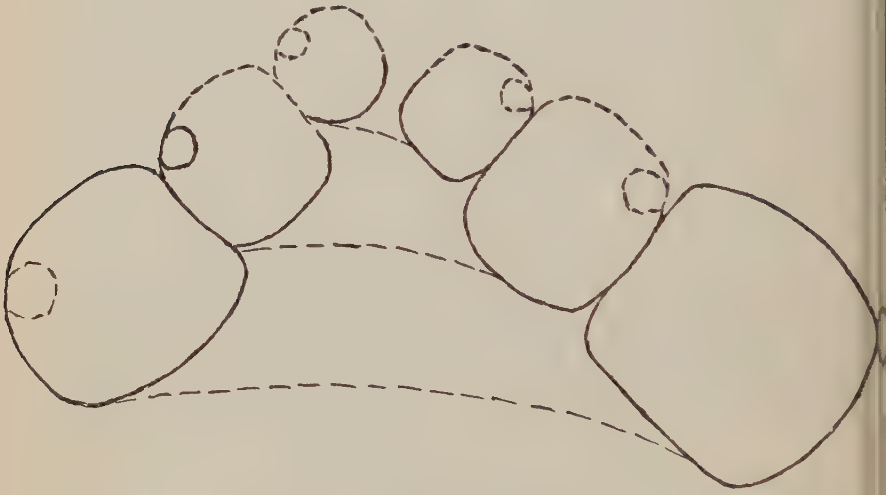

Fig. 38.

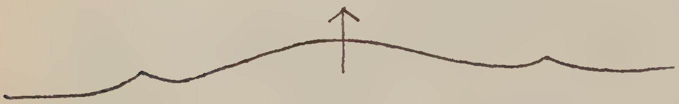

Fig. 39.

Figures 38 and 39 Mitroceras gebhardi (Hall).
Figure 38 Natural section seen in type specimen. Natural size.
Figure 39 Suture line of same.

Horizon and locality. Cobleskill limestone at Schoharie, N. Y.

Remarks. Mitroceras gebhardi is cited in Bassler's Bibliographic Index, as occurring at Buffalo, Williamsville and Akron, N. Y. This reference is on the authority of Professor Grabau, who identified a specimen collected by Messrs Vogt and Piper with the Cobleskill species. The specimen (see plate 21, figure 2) which has been cited and figured in various publications (see Grabau 1900, pl. 21, figures 30, 36; 1901; figure 149; 1906, figure 17; 1900, a pl. 31, figures 3*a*, 3*b*. 1910 *b*, figure 1290) is certainly not a

Mitroceras gebhardi, if we correctly understand the form, but may be a young individual of Foersteoceras turbinatum. The fact, however, that it lacks all traces of septa leaves its cephalopod nature doubtful. This specimen came from the "Bullhead" rock (Akron dolomite) and has been considered by Professor Grabau as important in the correlation of that bed with the Cobleskill limestone.

The State Museum contains five fragments of volutions of a form from the Bertie waterlime at Buffalo that have the character of those of Mitroceras gebhardi, as far as their much compressed condition allows of an identification. These have also been mentioned by Professor Grabau (1900, p. 371.). One of them, at least, shows the septa (see plate 17, figure 1) and their association in the Bertie waterlime rock with eurypterids is proved by the occurrence on the same small slab of a whorl and two segments of Eurypterus lacustris.

Foersteoceras turbinatum (Hall)

Plate 19, figure 1; plate 20, figure 1; plate 21, figure 1

Description. Conch a high mitriform, dextral torticone (apical angle about 55°), width to height as 2:3. Five or more volutions, which increase by about one-fifth of their diameter in one whorl, subelliptic in section, with a slight flattening on the upper inner side, along the contact of the whorls, the remainder of the inner side being well rounded as is the outer side of the whorl. Umbilicus large.

Living chamber apparently large, not known in full extent. Aperture unknown. Septa closely arranged, relatively deep (one-fourth as deep as wide), evenly convex. Sutures not distinctly seen.

Siphuncle fairly large, slightly nummuloidal with secondary deposits, situated marginal and below the strongest projection of the outer side.

Growthlines strong, irregular in size, swinging in sigmoidal curve across the outer side. Hyponomic sinus not distinctly seen.

Measurements. The holotype (Hall, plate 77, figure 1) with four volutions preserved measures 14 cm in height. Complete it would have measured about 19 cm and been 13–14 cm wide at the base, consisting of six or more volutions. The umbilicus is not quite half as wide as the basal diameter (about 6 cm in the holotype; conjectural). The siphuncle is about 5 mm wide in the last volution.

Horizon and locality. Cobleskill limestone at Schoharie, N. Y.

Remarks. The material before us representing this species consists besides the holotype of four specimens, one a larger individual than the type, preserving a septum on the right lower side, another preserving well the cast of the siphuncle; and another one the small impressed zone. The type specimen itself shows besides the outline of three volutions the cast of the inner side of the last whorl and a cast of the siphuncle. Also an outline of the section of the third volution, that is bodily preserved, is seen on the side. The shell was evidently fairly thick, as is indicated by the shell fragments preserved on the type specimen.

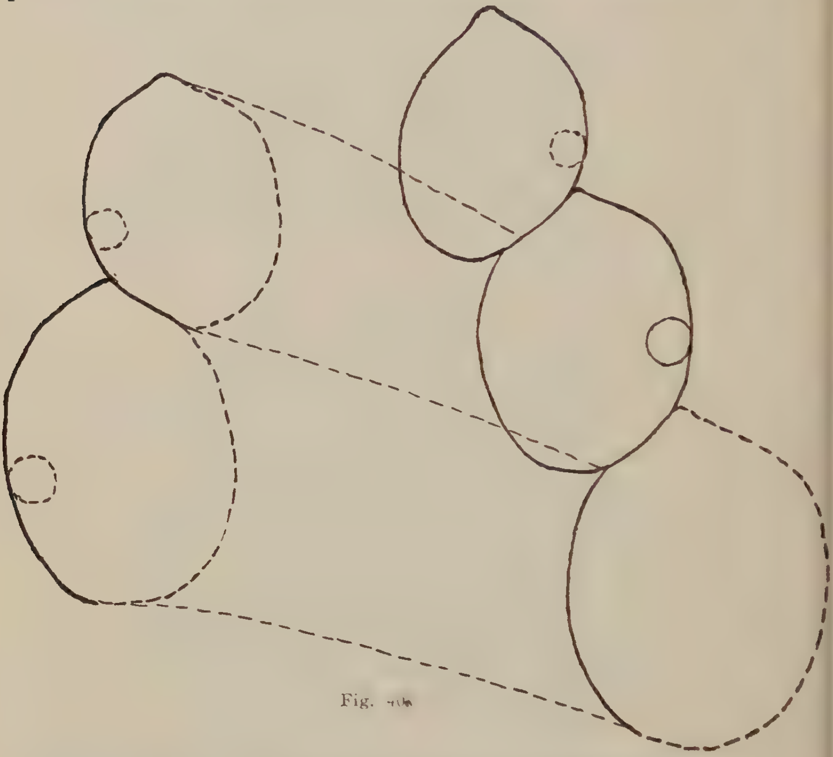

Figure 40 *Foersteoceras turbinatum* (Hall)
Section of type specimen. x 4/5.

XII CONULARIDA

Tentaculites sp.

A fragment of a large Tentaculites (width 4 mm) was found in the Gasport lens of the Lockport limestone. The transverse ridges are sharply projecting and number 11 in 10 mm. The interspaces show equal longitudinal striae, which however, do not seem to pass over the transversal ones. There is no species of that character known from the Lockport limestone.

Conularia niagarensis Hall

While Spencer and Derby found in the Lockport limestone at Hamilton a variation of C. niagarensis that has coarser ridges, we have before us seven specimens of a Conularia, from the Gasport lens of the Lockport limestone, that bear the characteristic niagarensis sculpture, but have the ridges markedly finer and more closely arranged. The ridges number 26–28 in 1 cm in one specimen, and are almost always above 20 in that interval, as against an average of 16 in niagarensis; although their number may sink in spots to 16. The size of these specimens is only half that of the niagarensis of the Rochester shale; the largest specimen observed does, not completed, reach 7 cm in length; and when compared with young specimens of niagarensis, it becomes apparent that the apparent difference in fineness of sculpturing is largely but one of relative age.

Conularia niagarensis var. **rugosa** Spencer

Conularia rugosa Spencer. Bul. Missouri State Mus., I, 1884, p. 9, pls. 8, 9, figs. 2, 2*a*; Trans. Acad. Sci. St Louis, 4, 1884, p. 608, pls. 8, 9, figs. , 2*a*; Bassler, U. S. Nat. Mus. Bul. 92, 1915, p. 275; Dyer, Trans. Roy. Soc. Canada, section IV, 1921, p. 65, 66, pls. 1, 2.

Spencer has described as Conularia rugosa a medium-sized form from the Lockport limestone at Hamilton, Ontario. More recently the species has been more fully described from better material by Dyer.

A comparison of C. rugosa with the common C. niagarensis Hall, which is most common in the Rochester shale, but also enters the lower Lockport limestone (according to Hall) brings out the fact that the general outline, angulation and sculpture are identical, the only difference that can be noted resting in the somewhat coarser arrangement of the transverse ridges. Spencer records ten ridges in 1 cm; Derby's figure shows variations from 10 to 14 in 1 cm. In C. niagarensis there are about 16 in 1 cm. in an average or typical specimen; but their number varies greatly so that 10 to 24 could be counted in one specimen in different places.

It would therefore seem that C. rugosa could be hardly more than a variety of C. niagarensis.

Conularia cataractensis nov.

Plate 22, figure 7.

Description. Shell of medium size, apparently thin, tapering uniformly except in apical portion where the rate of growth is more rapid. Cross section apparently broadly rhombic. Faces equal, moderately convex; apical angle of mature portion 35° to 40°. Marginal grooves deep, without prominent margins; facial groove very faint or absent. Aperture not known. Apex blunt. Apical septa unknown. Surface marked by very fine, sharply raised, threadlike ridges, numbering 40–50 in 1 cm separated by equal intervals, straight and meeting along the facial line in a distinct, wide angle (140°). The lines bear extremely minute prominent tubercles, numbering 4 in 1 mm. The intervals are smooth.

Measurements. Length of holotype 45 mm; greatest width (incomplete) 20 mm.

Horizon and locality. Whirlpool sandstone member of Cataract formation (Silurian); Niagara river gorge.

Remarks. Only one specimen is available of this species; an impression, which, however, retains the sculpture beautifully preserved in spite of the rather coarse grain of the rock. The extremely fine character of the sculpture, the closely crowded ridges will serve to distinguish this species from the Silurian congeners, save C. tenuicosta from the Gasport lens of the Lockport limestone which however, is still slightly coarser in ornamentation, slenderer in shape and possesses cross lines in the furrows.

Conularia tenuicosta nov.

Plate 22, figures 1–3

Diagnosis. Shell of medium size, very thin, noncalcareous, tapering uniformly, cross section square (?); faces equal, flat or but slightly concave; apical angle about 20° to 25°. Marginal grooves well defined; deep, with prominent, sharp edges. Central facial grooves faint. Aperture wide open, surrounded by low, rounded lobes. Apex bluntly pointed; apical septa unknown. Ornamentation consisting of fine, closely packed ridges (80–150 in 1 cm); arched gently across each face, meeting at a wide angle and without break in the marginal grooves and the central facial line; studded with small round tubercles. Furrows with fine lines connecting the tubercles of the ridges; smooth in some places.

Measurements. Length 5 cm, width of face 12 mm.

Horizon and locality. Gasport lens of Lockport limestone at Gasport, N. Y.

Remarks. We have four complete specimens of this beautiful Conularia before us, two of which are connected with their apices. The exact mode of attachment is not clearly visible, but presumably by a small attachment disk, such as we have described of C. gracilis Hall, (Ruedemann, 1896, p. 158 ff.). In the fine group of radiating specimens (Slater, 1907, pl. 2 fig. 1) of C. tenui

Slater such fixation disks are seen scattered over the center of the group. In another group of two fragmentary specimens of C. tenuicosta (see plate 22, figure 3) connected at the base, the impression of a disk can be distinctly seen. It lacks however, all chitinous substance.

There also occurs another mode of attachment in Conularia. Some 20 years ago the writer saw in the large collection of the late Frederick Braun in Brooklyn, N. Y., a magnificent group of gigantic Conularias, obtained by Mr Braun while collecting crinoids for Doctor Springer in the western Mississippian, that were attached to a common center by a finely preserved byssus. Unfortunately the Braun collection has not yet been acquired by any institution and this valuable specimen may become lost to science.

Conularia tenuicosta is readily distinguished from C. niagarensis by its slender form and extremely fine ornamentation.

Conularia filicosta nov.

Plate 22, figure 4

Description. Shell small, rate of growth diminishing toward aperture, giving shell a curved appearance. Cross section probably square. Relative sizes of faces not known. Faces gently concave; apical angle 20°. Marginal grooves deep, with prominent margins; facial groove only noticeable in apical portion. Aperture and apex not known. Surface marked by very sharply raised, threadlike, sometimes bifurcating ridges; numbering 25 in 10 mm, separated by intervals twice the width of the ridges; meeting at an angle of 130° and bent forward along the facial line. Intervals between ridges smooth.

Measurements. Length of holotype 26.5 mm; greatest width 12 mm.

Horizon and locality. Rochester shale, Niagara river gorge.

Remarks. This species in general character of sculpture is similar to Conularia bifurca Ringueberg (1886, p. 18); the latter, however, although known only in a fragment has clearly much more closely spaced ridges (20 to 1/8 inch or about 64 in 10 mm).

The ridges where fully preserved appear as black filiform bodies, resting on the surface of the shell.

Conularia perglabra nov.

Plate 22, figures 5 and 6

Description. Shell small to medium size; thin, slightly tapering more rapidly at the apex. Cross-section probably rhombic. Faces equal or nearly so; flat to very gently convex; apical angle of mature portions about 20°. Marginal grooves narrow, but deep, without prominent margins; facial groove broad, flat, marked by two sharp lines. Aperture wide open, bounded by large triangular lobes. Apex and apical septa unknown. Surface smooth, faint growth lines the only ornamentation.

Measurements. Length of type specimen 38 mm; complete about 45 mm; width of face 11 mm.

Horizon and locality. Bertie waterlime, North Buffalo, N. Y.

Remarks. We have two specimens of this peculiar form. One, the type, here described, is a normal straight Conularia shell; the other, however, is larger and flaring out towards the aperture in a manner not known to us from other conularias.

The smooth surface is the best distinguishing character of this species.

Serpulites corrugatus nov.

Plate 15, figure 11

Description. Tube large, attaining a width of 8.5 mm, fairly rapidly expanding (in a length of 30 mm from 7 mm to 8.5 mm), of unknown length. Marginal welts sharply defined, thick and prominent (.8 mm wide). The body of the tube formed by a thin chitinous test that is densely wrinkled longitudinally, looking like tissue paper.

Horizon and locality. Rochester shale, Niagara river gorge.

Remarks. The writer had occasion to describe a number of species of Serpulites, mostly from the Ordovician, in New York State Museum Bulletin 189. To these is added here a large type from the Rochester shale, that is remarkable for its sharply defined lateral welts and the intense wrinkling of the thin test. In its dimensions the Rochester form recalls S. longissimus Murchison, the genotype and well-known British Silurian form. It differs, however, from the latter in its thinner test, which in S. longissimus appears transversely plated as in S. lumbricoides Ruedemann, a Trenton form, instead of being closely wrinkled longitudinally.

Serpulites sp.

The presence of a species of Serpulites in the Bertie waterlime is indicated by chitinous-phosphatic welts of the tubes about 1 mm apart. The form seems to have been a small and very slender one, similar to an undescribed species of the Clinton shales.

XIII CRUSTACEA

Ceratiocaris acuminata Hall

Plate 16, figure 1

Hall (1859, p. 422) described this large Ceratiocaris from a carapace found in the Bertie waterlime at Buffalo. Later a whole specimen was described and figured by Pohlman (1886, p. 28) as coming from the same formation and locality; and still another complete specimen in the Buffalo Museum of Natural History was figured by Grabau (1901, p. 227). The New York State Museum contains an equally perfect large specimen, here figured, and a telson,[1] dorso-ventrally compressed, that indicates an individual nearly a foot long.

It appears from these specimens that this large phyllopod crustacean possessed a bivalved carapace of somewhat variable outline (which however may be partly due to preservation), which in general was subtrapezoidal, the longer (antero-posterior) diameter of which is a little more than twice the height of the carapace valve (as seen in compressed condition). The median (dorsal) line is nearly straight, slightly convex, gently converging to the mucronate anterior point of the carapace. The ventral margin is strongly convex, forming in the anterior nearly straight half an angle of about 50° with the general dorsal line, then bending fairly sharply and converging gently towards the subtruncate posterior margin. The latter is gently incurved, receding forward and upward. A rostrum has not been seen in any specimen. Gastric teeth are observable in the specimen figured by Grabau and the one in the New York State Museum. They are situated one-fifth of the length from the anterior extremity and a little nearer to the ventral, than the dorsal margin. Ocular nodes have not been seen.

There are five segments visible outside of the carapace and more or less distinct outlines of two more inside the carapace. The last of these is twice as long as the preceding ones. The three caudal spines consist of the long, aculeate telson, which bears a median ridge, and the two flat lanceolate cercopods, about five-sevenths the length of the telson.

The surface is provided with very fine, raised longitudinal lines, which towards the ventral side may become coarse enough to be seen with the naked eye. On the segments there are transversal lines, which on the anterior exposed segments are straight transversal, on the posterior ones become wavy and are restricted to the anterior portions (see plate 21, figure 1).

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[1] A similar telson was figured by Stose (1894, p. 371).

The specimen figured by Pohlman measured 7 inches in length, Grabau's type and the specimen in the New York State Museum measure 8 inches in length. An abdomen in the State Museum, preserving four segments and the caudal spines measures 6 inches and the entire specimen must have measured about 11 inches.

Horizon and locality. Bertie waterlime at Buffalo.

Ceratiocaris maccoyana Hall

Hall (1861, p. 421) has distinguished three species of Ceratiocaris from the Bertie waterlime at Buffalo. The best known of these is Ceratiocaris acuminata. C. maccoyana is based on five specimens, only one of which, showing the carapace (*op. cit.* plate 84, fig. 2) is of diagnostic value.

This is distinguished from that of C. acuminata in having the greatest width and convexity in front of the middle line of the carapace and a width which is one-half the length of the carapace.[1] The carapace is thus relatively shorter or wider, a relation that also expresses itself in the greater angle (about 60°) formed by the dorsal and anterior ventral margins of the carapace.

No further specimens except those described by Hall have become known and the species is still incompletely known. It is entirely possible, that larger collections in the future will prove that the two species C. acuminata and C. maccoyana grade into each other, or that the differences are those of sex.

Ceratiocaris aculeata Hall

Another Bertie waterlime species described by Hall (1861, p. 422) is Ceratiocaris aculeata. Since, however, it is based only on a penultimate segment with the caudal spines and the type is not available, the species is doubtful. Hall saw its diagnostic characters in the broader basal portion and the strong groove of the telson spine, and the strong striation of the test of the penultimate segment. The relative bluntness of the telson spine is, however, quite possibly due to the younger age of the individual, indicated by the small size of the appendage; and the median ridge of the telson spine, as well as the strong striations of the segments are also present in C. acuminata and other species.

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[1] These relations are obtained from the figures of the types, the latter themselves being at present not accessible in the American Museum of Natural History.

Ceratiocaris (Limnocaris) clarkei nov.

Plate 23, figures 2-4

The State Museum contains three remains of Ceratiocaris which were all collected in one drift block of Bertie waterlim at the Woodlawn Cemetery at Canandaigua, N. Y., by Doctor Clarke. One is a "mandible" (gastric teeth), another a cercopode and the third is a carapace with five projecting abdominal segments.

The latter proves to represent a new form, different from the preceding species in the relative shortness, or greater width of the carapace. This difference finds its most distinct expression in the ventral margin, which is decidedly more convex than that of either C. acuminata or maccoyana. The width of the valve (26 mm) as compared to the length (46 mm measured diagonally) is greater by one-eighth of the length than half the latter, while in C. acuminata it is smaller than half the length and in C. maccoyana about equals it. The dorsal margin is remarkably straight, except the frontal fourth which bends more sharply than in the other species to the anterior point. The ventral margin, as stated before, is distinctly more convex, the bulging becoming more marked by the stronger contraction of the posterior half of the valve. Also the posterior margin is more strongly incurving than in the two associated species. In accord with the generally more contracted appearance of the form is the relatively short abdomen, which is 30 mm long, and contracts in that length from a width of 12 mm to one of 5.5 mm at the distal end of the penultimate segment or by more than one-half. Its relative contraction is thus greater than that of C. acuminata where it contracts by one-third only, but may agree with that of C. maccoyana, if the original of Hall's figure 3 belongs to that species.

The surface sculpture is the same as in the other species.

There is a distinct eye node observable as a circular depression (the valve being seen in the mould), which would bring the form under Limnocaris (see Clarke, 1901, p. 93), if the absence or presence of that node is to be recognized as a generic difference.

Ceratiocaris (Limnocaris) praecedens Clarke

Doctor Clarke (91, p. 92) has fully described this stately crustacean which was found in the Pittsford shale in association with the eurypterids. It resembles in the form of the carapace the later C. acuminata Hall, but possesses a clearly defined ocular spot and has for that reason been placed in a subgenus Limnocaris.

Later collections have furnished little that would add to the original description, except a "mandible" and which judging from its size may well have belonged to this species if not to an unknown crustacean. It is preserved in section which brings out the remarkable sharpness of the cusps of these gastric teeth and their "dendroid" structure, showing a central solid axis, upon which rests vertically a fibrous or blocky substance of dark color and phosphatic appearance. The basal portion of the mandible is obviously not fully preserved.

Ceratiocaris deweyi Hall

Hall described this form first as Onchus deweyi (1852, p. 320), considering it a fish spine, but corrected his error in 1859 (p. 83) when he recognized the fossil as the telson spine of a crustacean and tentatively referred it to McCoy's new genus Ceratiocaris. Grabau (1901, p. 227) suggests bringing the fossil under Phasganocaris Novak, proposed for Lower Devonian abdomina and spines of Bohemia, with scaly surface and spinose edges. Jones and Woodward (1888) have described and figured a number of species, as C. murchisoni and C. gigas, bearing exactly the same sculpture as C. deweyi, from the lower Ludlow.[1]

Strangely enough also more recent collections seem to have afforded only the picturesque telson spines. These are found in the Rochester shale, where Hall's original specimen came from. Grabau (1901, p. 228) records them also from the Lockport limestone at Niagara.

Emmelezoe minuta nov.

Plate 24, figure 4

The presence of the rare crustacean genus Emmelezoe in the Bertie waterlime is attested by a single small carapace, 4 mm long and 2 mm wide. Its outline is pod-shaped, the anterior extremity broadly rounded, the posterior subtruncate; the dorsal margin slightly divergent in the posterior two-thirds, then turning rather sharply downward· the ventral margin fairly evenly and slightly convex; except in the anterior region where it converges towards the anterior extremity. The ocular tubercle is distinct and close to the dorsal margin. The cordlike rim of all margins, except the dorsal one, is noticeable, although not very prominent. The surface sculpture consists of subparallel, somewhat wavy, longitudinal lines, numbering about 16.

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[1] It may be mentioned here that the spine figured by Jones and Woodward together with the spines just mentioned of Ceratiocaris (*op. cit.* pl. 5) as Xiphocaris ensis (Salter) and which is made the genotype of their new genus Xiphocaris (Jones and Woodward, 1886, p. 233) is undoubtedly the telson spine of an Eusarcus, and therefore referable to the eurypterids. This is especially clear from the subrhomboidal section (*ibid.* fig. 7*b*), the scarlike surface sculpture and the peculiarly notched etches (figures 7*c*, 7*d*), all features well exhibited in all telson-spines of Eusarcus. The term Xiphocaris becomes then a synonym of Eusarcus (a name proposed in 1875).

Horizon and locality. Bertie waterlime at Buffalo.

Remarks. There has hitherto been described but a single species, E. decora Clarke from American rocks (Clarke, 1901, p. 95). This came from the Pittsford shale at the base of the Salina beds, and like the Bertie waterlime species is associated with the eurypterids. Although much larger it is very similar in outline to our species and quite probably a direct ancestor of the latter. Judging from the single carapace before us, the Bertie waterlime form would differ, besides being only one-third to one-fifth the size of the other, in being relatively more elongate and more acute anteriorly. The accurate distinction of our species awaits, however, the collection of fuller material. Meanwhile, the find is mainly of interest as adding another crustacean member to the peculiar Bertie waterlime fauna. In Great Britain the genus is represented by three species, all Upper Ludlow forms.

Anomalocaris(?) **kokomoensis** nov.

Plate 23, figure 6

The State Museum received, from the Kokomo waterlime at Kokomo, Ind., among a series of eurypterids, a fossil that had been considered by the collector as a leg of Dolichopterus, but which proved to be a problematicum that probably has no relation to the eurypterids. It bears, however, a striking resemblance to the strange fossil that has been described and figured as the abdomen of Anomalocaris canadensis by Whiteaves (1892, p. 205) and Walcott (1908, p. 246), and may be therefore tentatively referred to that still little known genus of early crustaceans.

It consists of a series of fairly distinct segments, about 17 in number, forming an abdomen that is about 60 mm long, and 10 mm wide at the proximal end, tapering somewhat irregularly to one or several caudal spines. The segments, which are completely flattened, appear subtrapezoidal, with the broader side upward and the height a little greater than the base in the middle segments, but about 3 times greater in the anterior ones. The appendages are hooklike bent in the proximal portion, and straight or but slightly curved backward in the distal portion. They are of about the same length throughout, except the last ones. In several of the first appendages there are indications of branching near the bases.

The fossil, not very favorably preserved and known only from a single specimen, is of interest mainly on account of its occurrence in the Kokomo beds in association with the eurypterids. Its nature is wholly problematical and it is even possible that it belongs with the filamentous appendages of unknown connection with the eurypterids, described by Clarke and Ruedemann (1912, p. 314) from the Shawangunk grit, and which offer a suggestion of similarity with the supposed combs of the Carboniferous Glyptoscorpius as described by Peach.

Lepidocoleus reinhardi nov.

Plate 23, figure 5

Diagnosis. Shell of large size (60 mm long, 10 mm wide, composed of more than 18 (probably 21) plates in a column. Plates about 3 times as wide as long on exposed part (not counting overlap). Amount of overlap and surface sculpture unknown.

Horizon and locality. Bertie waterlime at Williamsville near Buffalo, N. Y.

Remarks. This species is based on a single specimen, which is only a cast of the interior of one row of plates; a small part of this row is broken out. It would, on account of this imperfect preservation, hardly invite description, were it not for the reason that there are so few species of that genus known and each again by but one specimen, so that each new find is worth recording; and moreover that this type was obtained from the Bertie waterlime which before has rarely afforded anything but eurypterids; and finally that the specimen contrasts with its congeners by its large size and great number of plates.

The fact that only the interior cast is present prevents the observation of the exterior sculpture and of the amount of overlap of plates, only the posterior margins of the plates being seen.

The outline of the specimen, which is bent upon itself with the ventral side outward, is elongate blade shaped, the length being 6 times the width, and the margins are fairly parallel, with a very slight contraction toward the base and a gradual one towards the acutely triangular terminal plate. The plates appear closely arranged and relatively short, but they may have overlapped by as much as one-half their lengths as in some of the other species.

The posterior margins of the plates are sigmoidally flexed, in basal direction on the dorsal or "fixed" side and more strongly in apical direction on the ventral side. The ventral margins of the plates are straight. The flexed basal plate is apparently not completely preserved. The impression of the plates is concave along the ventral margin, gently convex upon the middle and sharply convex and bent down on the dorsal side giving the impression that the plates may have possessed considerable thickness and been thinner along the ventral margins. The subcircular muscle-scar observed by Withers (see *postea* p. 654) near the middle of the inner surface of each plate is recognizable in the larger lower plates in a small subcircular elevation a little towards the dorsal side from the median line.

Since the erection of the genus by Faber for a Cincinnati specimen, there have become known beside the genotype L. jamesi (Hall and Whitfield), two species from the New York rocks, namely, L. sarlei Clarke from the Rochester shale at Rochester and L. polypetalus Clarke from the New Scotland beds (Lower Devonian) of Albany County (J. M. Clarke, 1896, p. 137); each known in only one specimen; one species L. illinoiensis Savage from the Upper Oriskany of Illinois (see Savage, 1913, p. 149), one species from the Ordovician (Trinucleus shale) of Sweden (L. suecicus Moberg, see Moberg 1914) and one from the Upper Ordovician of the Girvan district in Scotland (L. grayae Withers, see Withers 1922), the last two known only in one or two fragmentary specimens. Bather (Bather, 1914, p. 559) in reviewing Moberg's paper mentions also a large form detected by Mr Withers among the Wenlock fossils of the British Museum and one from the Middle Devonian near Olmütz, Moravia, both of which are as yet undescribed. To these is added another record of an undescribed species from Bohemia by Withers (1915, p. 121).

The complete list of the species is hence as follows:

Lepidocoleus jamesi (*Hall and Whitfield*), Cincinnatian, Ohio
- L. suecicus *Moberg*. Trinucleus shale, Sweden
- L. grayae *Withers*. Upper Ordovician, Scotland
- L. *sp.* undescribed (" Squamula bohemica " Barrande, on label) Ordovician, Bohemia.
- L. sarlei *Clarke*, Rochester shale (Silurian), New York
- L. *sp.* undescribed. Wenlock, England
- L. reinhardi *Ruedemann*. Bertie waterlime, New York
- L. polypetalus *Clarke*. Lower Devonian, New York
- L. illinoiensis *Savage*, Middle Devonian, Illinois
- L. *sp.* undescribed, Middle Devonian, Moravia.

While more or less complete specimens are extremely rare, it would seem that detached plates are common or even abundant, especially those of L. jamesi. It is, however, quite certain that a variety of plates from various Ordovician beds of America have been referred rather loosely to this species, especially by the present writer. These, on closer study will probably prove to represent new species of Plumulites and Turrilepas, such as have been described from detached plates by Moberg from Sweden and by Withers from Esthonia (Withers, 1921).

L. reinhardi seems to be distinguished readily from all congeners by its much greater size and greater number of plates in each column. It is especially distinct from the other Silurian form of New York, L. sarlei Clarke in having 18+ (20) plates as against 12 and 13 in the latter. It is also nearly thrice as large and the plates differ much more in relative size, those of the apical portion being much smaller than the basal ones, in the Bertie waterlime form. In the large number of plates L. illinoiensis from the Clear Creek (upper Oriskany) chert in Union county, Illinois, comes nearest to our form; Savage having counted 17 plates on one and 13 on the other side, neither side being complete. It is also larger than the congeners except L. reinhardi which is still twice its size.

We can not consider here the difficult question whether these forms are really Cirripedia, a question raised by Withers (1915, p. 121 ff.), who points out that we know nothing of the relation of the animal to the shell, and that " except for the ornamentation and the downward growth of the plates there seems to be no other character advanced in favour of their reference to Cirripedia "; while on the other hand, Jouleaud (1916, p. 7 pp.) in his essay on the general evolution of the primitive and pedunculate Cirripedia with calcareous shells would unite the genera Lepidocoleus, Plumulites, Turrilepas and Strobilepis under the term " Proto-cirripedia " as the true ancestors of the pedunculate Cirripedia.

Leperditia altă (Conrad)

Some strata of the Bertie waterlime are entirely covered with a poorly preserved, crushed ostracod, that in general outline and dimensions agrees with L. alta (Conrad). Indeed has this species been cited from the Rondout waterlime of New Jersey by Weller (1909, p. 259) and the Bertie waterlime by O'Connell (1916, p. 87).

The larger form, that is common in the overlying " Bullhead " (Cobleskill) limestone, is the L. scalaris (Jones). It has been repeatedly figured by Grabau (see Bassler's Index, p. 705.).

Besides the larger Leperditias also smaller ostracods were observed. They are, however, undeterminable since the shells are not preserved. The most notable among them is an elongate cylindric form, about 1 mm long.

Leperditia scalaris (Jones)

Leperditia scalaris is a common and characteristic fossil of the Cobleskill limestone in eastern New York and of the corresponding Akron dolomite of western New York. Several fine examples of this stately ostracod have also been obtained in the Bertie waterlime of North Buffalo.

XIV ARACHNOIDEA

Bunaia woodwardi Clarke

Plate 24, figures 1–3

Bunaia woodwardi Clarke. Geol. Mag. N. S. Decade VI, VI, p. 531–2, 1919.

Bunaia woodwardi Clarke. N. Y. State Mus. Bul. 219, 220, 1921, p. 129–31, pl. 1.

This remarkable merostome, a vicarious genus of the well-known Baltic Bunodes, has been as fully described as the material permits. Its chief interest lies in emphasizing the presence of bunodomorph merostomes such as are associated with the eurypterids in the Baltic region, in our Bertie waterlime.

No new material has come to hand since the species was described.

Hemiaspis (?) eriensis Clarke

Hemiaspis (?) eriensis Clarke, N. Y. State Mus. Bul. 251, 1924, p. 119.

A very imperfect merostome from the Bertie waterlime at Buffalo has been recently figured as Hemiaspis (?) eriensis by Doctor Clarke (1924, p. 119). As this genus thus far was known only from the Silurian of Great Britain, the note was merely intended to point out the occurrence in America of this strange type of arachnoid.

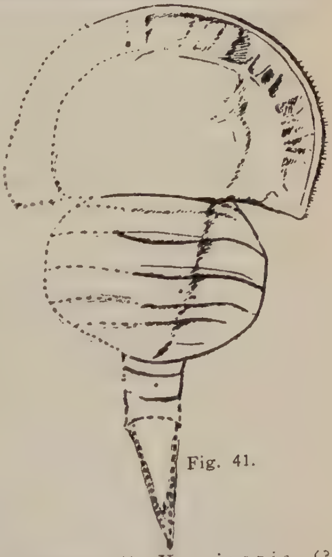
Fig. 41.

Figure 41 Hemiaspis (?) eriensis Clarke. Original figure.

Pterygotus sp.

Plate 23, figure 7

The "Bullhead" rock of the Buffalo cement beds has afforded a ramus of a Pterygotus that, while poorly preserved, invites description because it is the first eurypterid from that much discussed stratum, and because it shows some features distinct from those of other species of Pterygotus.

The fragment is about 50 mm long and 5 mm wide, the main body nearly straight and but gently tapering towards the front. The distal end is partly broken; it seems to have been as in P. buffaloensis. Only the teeth of the first order are observable and these stand partly straight upward (the two longest), and partly obliquely forward. This is a peculiar combination, the teeth in other species being usually so arranged that the free ramus has vertical, the fixed ramus slanting teeth (see Clarke and Ruedemann, pl. 77). It is therefore quite probable that the ramus as described represents a new form, as yet not sufficiently known to be determined. Both the ramus and the teeth are not compressed into a film as in the Bertie waterlime specimens, but preserved as well-rounded cavities that indicate a very solid massive structure of the original organ.

The occurrence of this fossil is further interesting as the first find of an eurypterid in the " Bullhead " bed. This bed has had a somewhat checkered career. Originally included with the Salina dolomite (later Bertie waterlime) which it overlies, it was separated from the Bertie waterlime by Grabau (1900 and 1901) and correlated with the Manlius limestone. Hartnagel (1903 and 1912) considered it as the western continuation of Hall's Coralline limestone (Cobleskill Hartnagel), and Schuchert (1903, p. 175) in the same year referred it to the Coralline limestone which he made the lower member of the Manlius formation. Grabau, (1909, p. 550) who later also considered it as faunally linked to the Cobleskill of eastern New York, has termed it Akron dolomite. As such it is now again held to be more closely connected with the Bertie waterlime, (Ulrich, 1911 chart, N. Y.; Williams, 1919, p. 87 ff.) and termed but an upper member of the Bertie (personal information by Professor Chadwick), to which it is bound by lithic gradation.

While the fauna of the Bertie waterlime consists mainly of eurypterids, the fossil here described is the first eurypterid recorded from the Akron dolomite. The specimen was associated in the same block with abundant individuals of Cyathophyllum hydraulicum Simpson, the most common and characteristic fossil of the bed.

Eurypterus lacustris Harlan

Eurypterus lacustris has been described by Clarke and Ruedemann (1912, p. 177) as occurring only in the Bertie waterlime. We have now before us three specimens: one the carapace, the other a portion of the abdomen and the third a segment, all of mature individuals of this species, from the Akron dolomite (" Bullhead ") of the quarries of North Buffalo, N. Y. This occurrence, together with the finding of a chela of a fairly large Pterygotus (see above) leaves no doubt of the persistence of at least a part of the eurypterid fauna of the Bertie waterlime into Cobleskill time.

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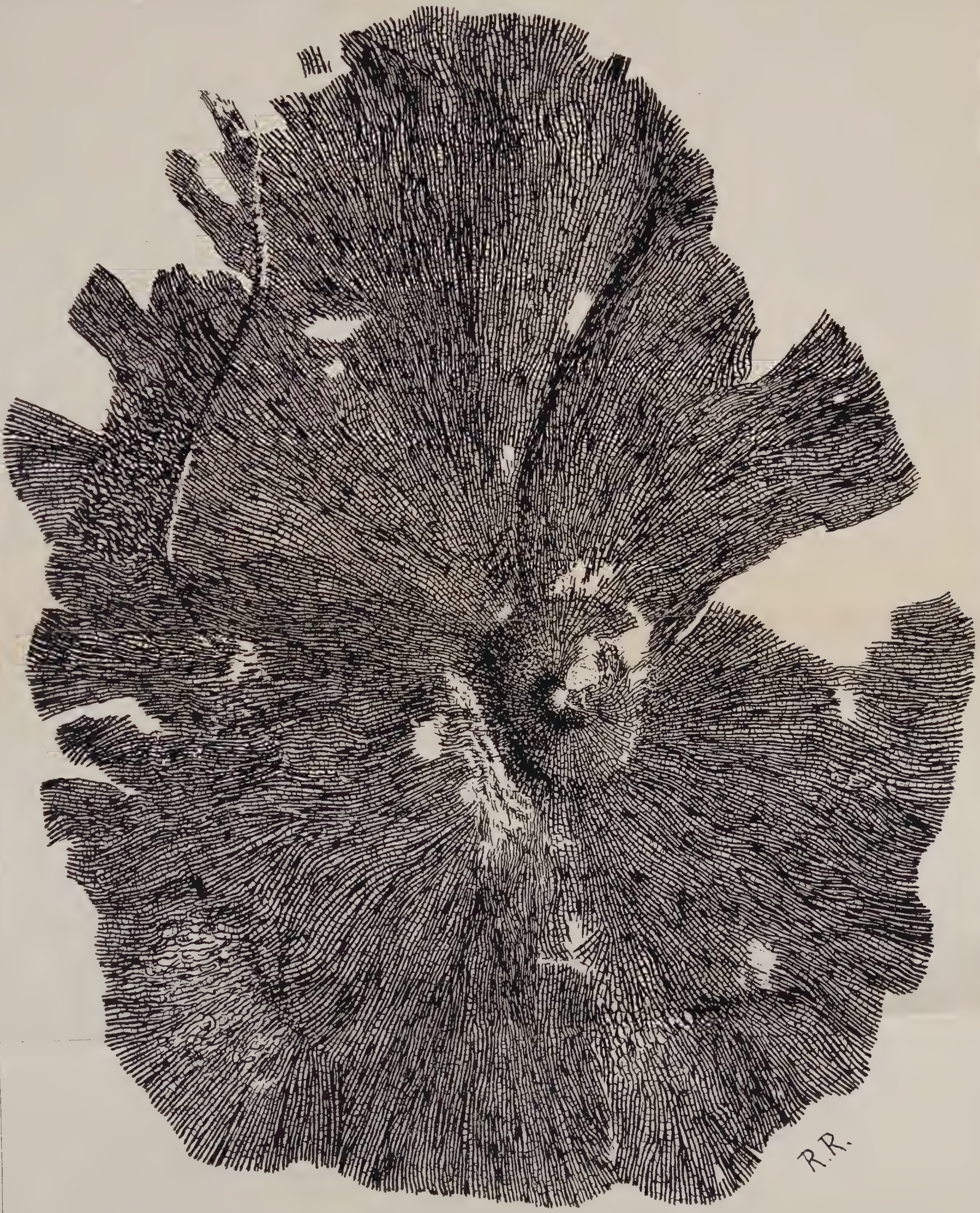
Explanation of Plates

Plate I

Dictyonema crassibasale Gurley

Page 22

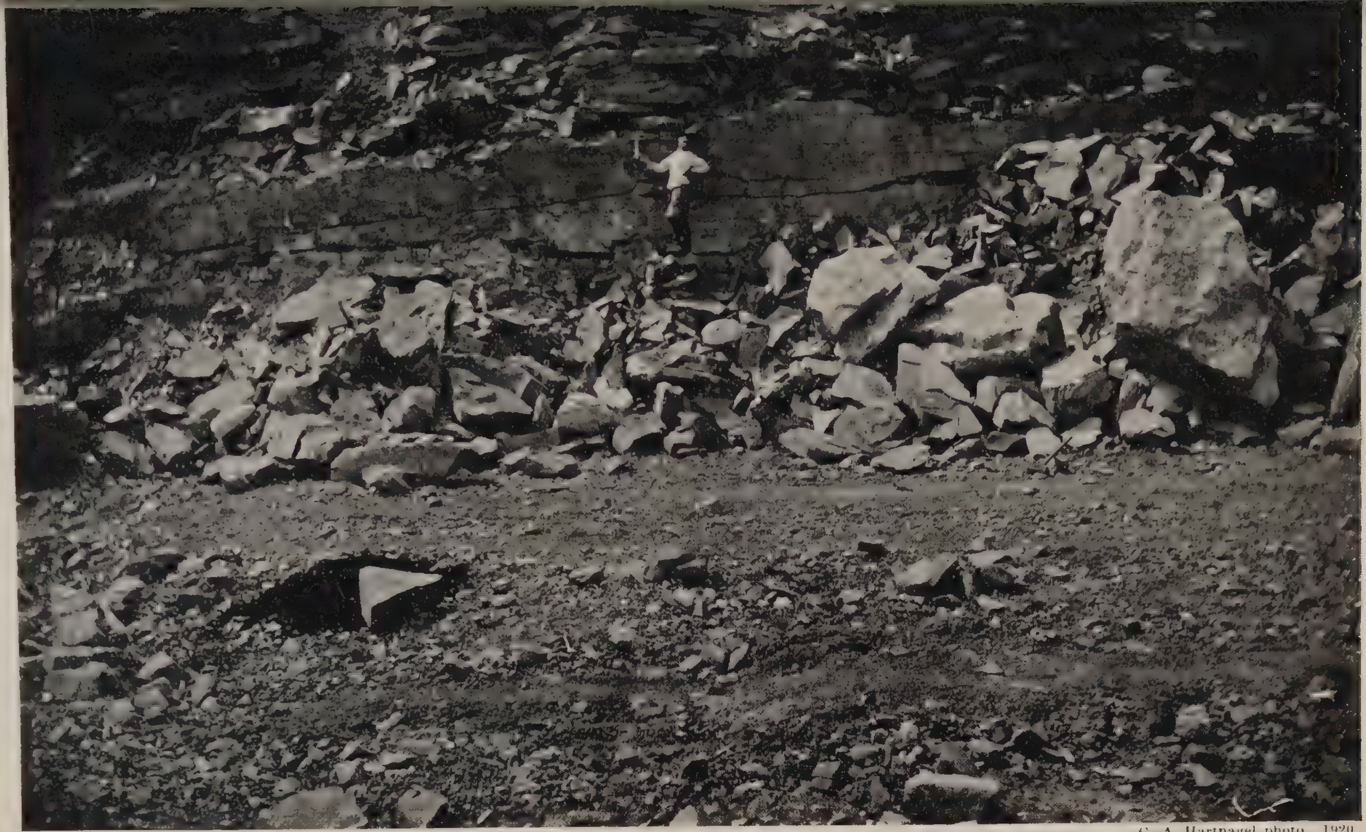
Figure 1 Large specimen, natural size. Lockport limestone, Hamilton, Ontario.



E. Stein photo., R. R. del.

Plate 2

Portion of Gasport channel, showing contact with Lockport limestone above at top, and below at left.



C. A. Hartnagel photo., 1920.

Portion of Gasport channel, showing contact with Lockport limestone on top

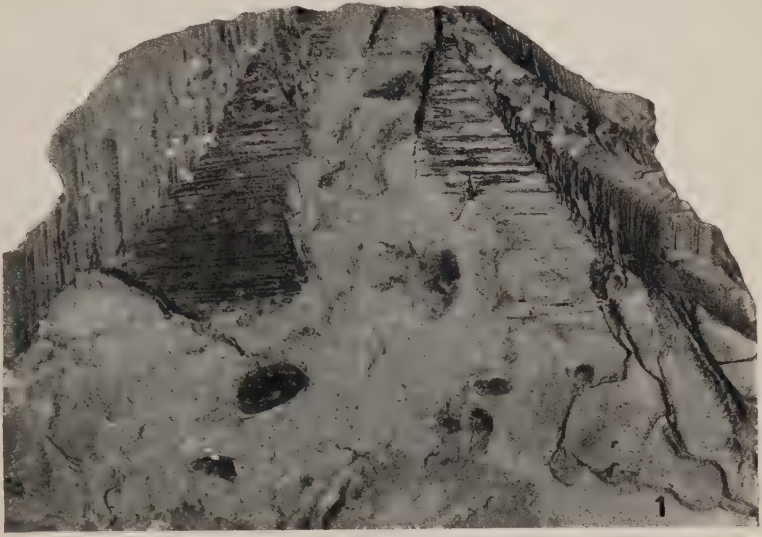
Plate 3

Figure 1 Dolomitic slab of Camillus shale, containing casts of salt crystals and specimens of Ctenodonta salinensis Rued.

Town of Lenox, Madison county, N. Y.

Figure 2 Casts of salt crystals in Bertie waterlime, North Buffalo, N. Y. Photographs about natural size.

Originals in New York State Museum.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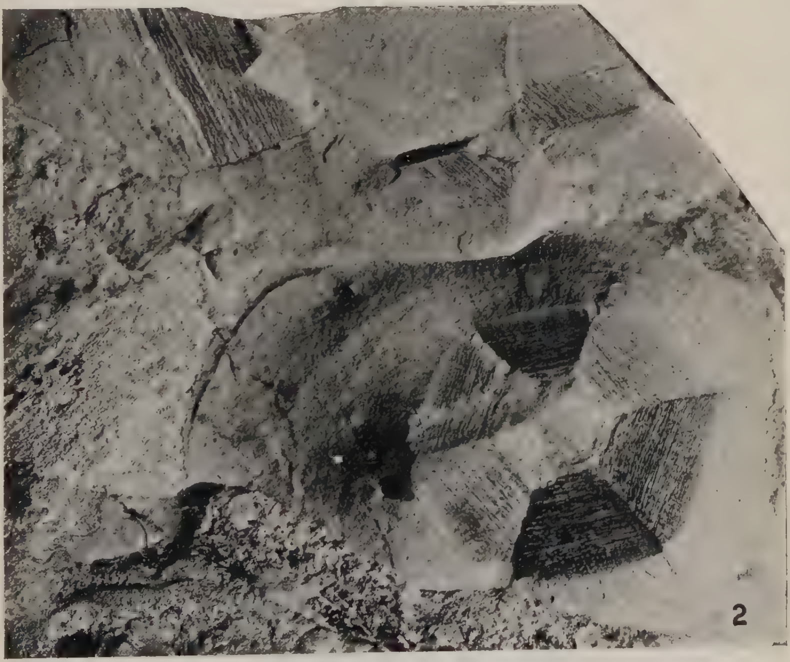
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E. Stein photo.

Plate 4

Morania (?) **bertiensis** Ruedemann.

Page 16

Figure 1 Specimen (type). Bertie waterlime. North Buffalo, N. Y.

Sphenophycus (?) sp.

Page 17

Figure 2 Supposed flotation appendage of alga. Bertie waterlime. Litchfield, Herkimer county, N. Y.

Figure 3 Appendages of unknown origin, doubtfully referred to preceding fossil. Bertie waterlime. North Buffalo, N. Y.

Calithamnopsis silurica Ruedemann.

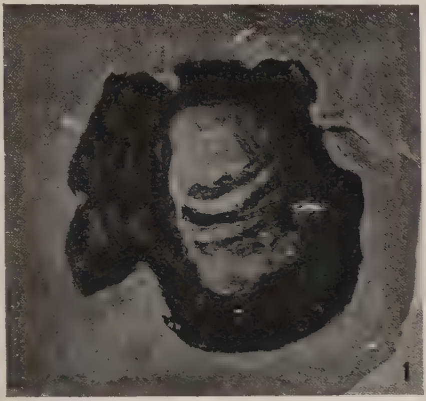
Page 15

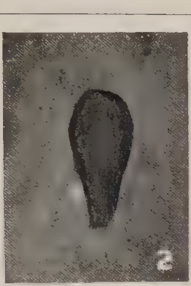
Figure 4 Holotype. Bertie waterlime. North Buffalo, N. Y.

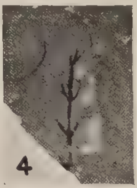
Chondrites verus Ruedemann.

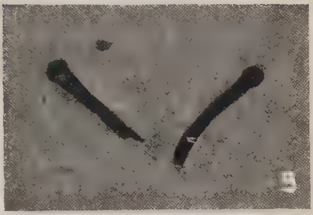
Page 15

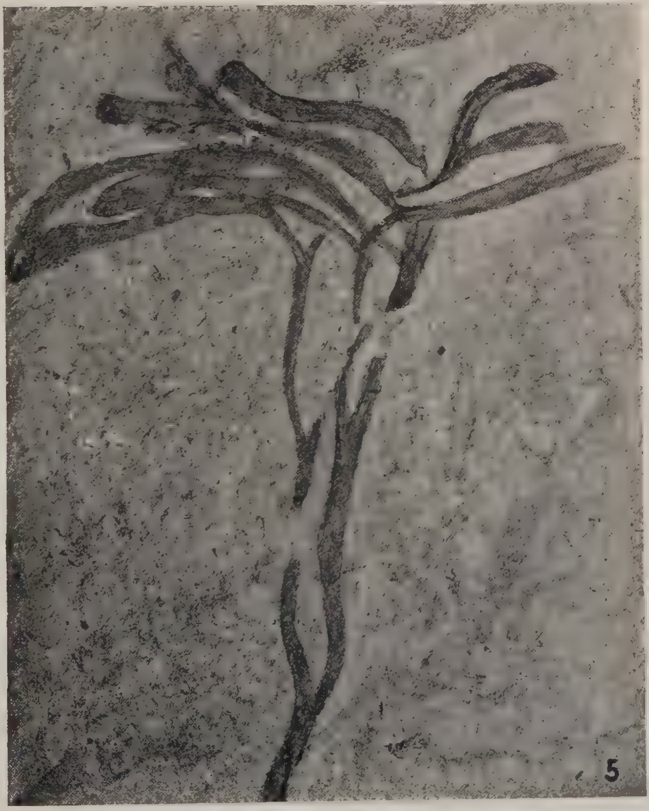
Figure 5 Holotype. Gasport lens of Lockport limestone. Gasport, N. Y. All figures are natural size. The originals are in the New York State Museum.











E. St. et E. P. photo., R. R. del.

Plate 5

Hostimella silurica Goldring.

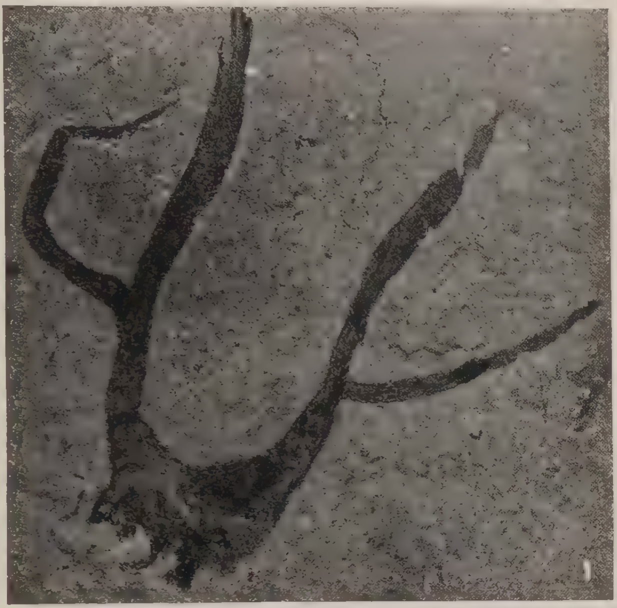
Page 17

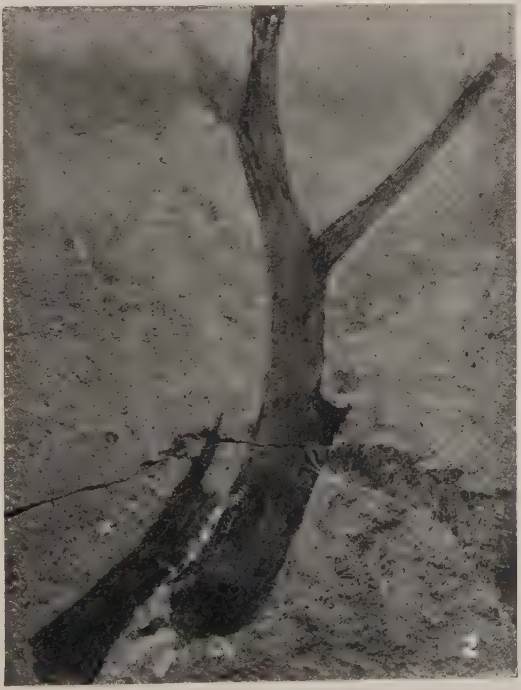
Figure 1 Specimen of irregular form. Cotype.

Figure 2 The type.

Bertie waterlime. North Buffalo, N. Y.

Figures are natural size. The originals are in the New York State Museum.





E. Stein photo.

Plate 6

Ascograptus similis Ruedemann

Page 18

Figure 1 Supposed basal disk. x 12.

Figure 2 Group of three distinct thecae. x 12.

Figure 3 Group of thecae with central body or section of axis. x 12.

Figure 4 Similar group with larger thecae. x 12.

Figure 5 Group showing connecting filament. x 12.

Figure 6 Most complete radiating group observed. The type. x 14.

Figure 7 Group, like preceding, suggestive of spiral arrangement of thecae. x 12.

Figure 8 Restoration of rhabdosome.

Gasport lens of Lockport limestone; Gasport, N. Y.

The originals are in the New York State Museum.

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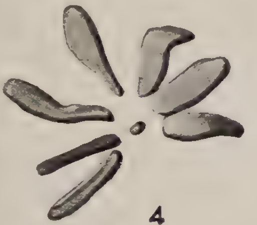
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R. R. et E. K. B. del.

Plate 7

Diplospirograptus goldringae Ruedemann.

Page 34

Figure 1 Portion of colony retaining both the double spiral axes and the thecal tubes of one branch. Natural size. Type.

Figure 2 Usual appearance of the axes, as wavy branches, when stripped of the thecal tubes. Natural size. Cotype.

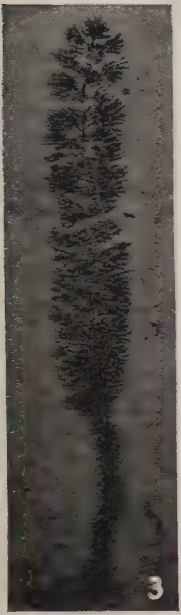
Figure 3 Large branch with distinct bundles of branching thecae. Natural size. Cotype.

Figure 4 Theciferous branch, showing the density of the distribution of the thecae.

Figure 5 Branch x 3, to show more distinctly the multifid character of the thecae. Cotype.

Figure 6 Restoration of appearance of whole colony. Natural size. Lockport limestone (Gasport lens), Gasport, N. Y.

All originals are in the New York State Museum.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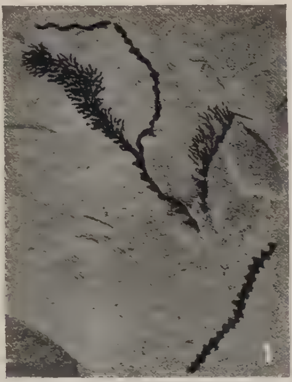
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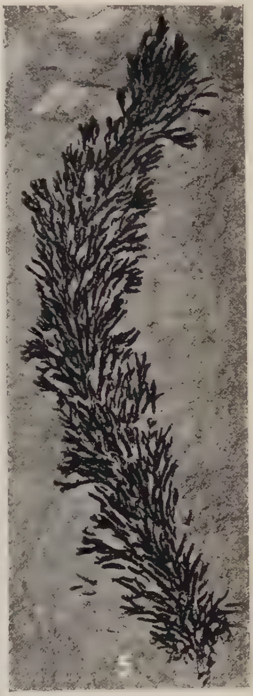
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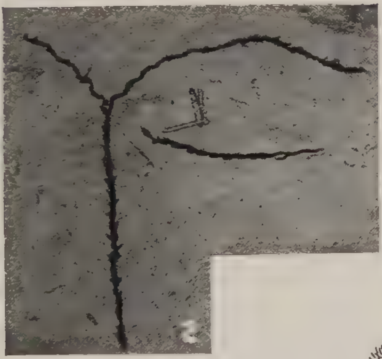
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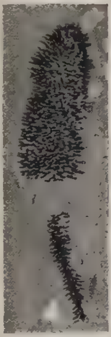
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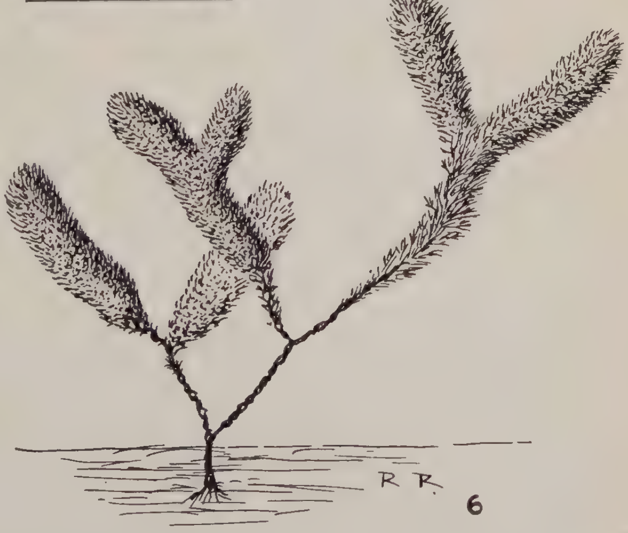

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E. S. et E. P. photo., R. R. del.

Plate 8

Medusaegraptus graminiformis (Pohlman)

(See plate 13, figure 1)

Page 30

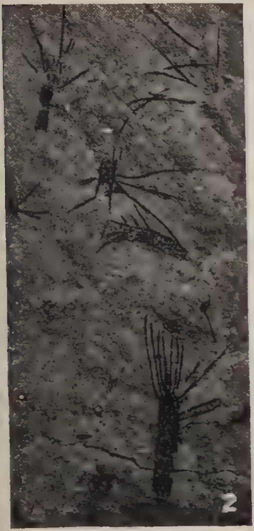
Figure 1 Portion of slab with "Chondrites graminiformis" Pohlman. Natural size.

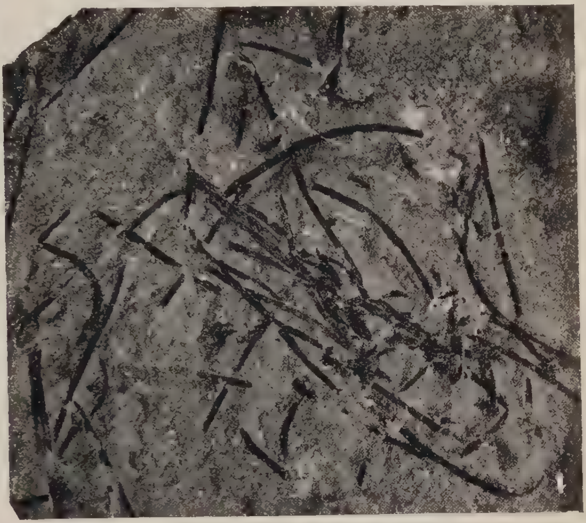
Figures 2, 3 Portions of slabs with young rhabdosomes. x 3. In the center of figure 3 cross sections of the rhabdosomes are seen.

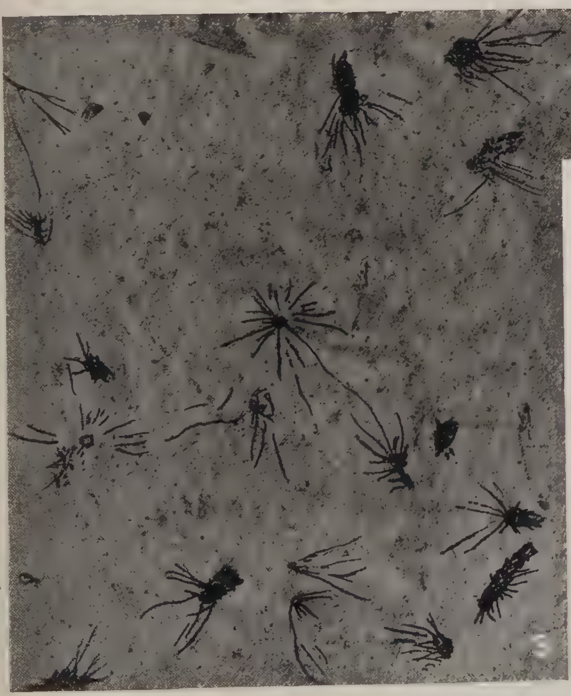
Figure 4 Part of mature specimen, showing the thecal tubes at distal end. Natural size.

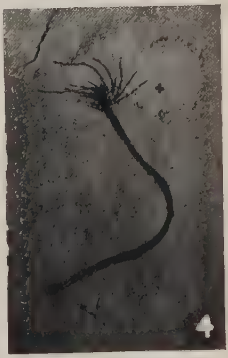
Bertie waterlime, North Buffalo, N. Y.

The originals of the figures are in the New York State Museum, save that of figure 1, which is in the Museum of the Buffalo Society of Natural Sciences.









E. S. et E. P. photo., R. R. del.

Plate 9

Medusaegraptus mirabilis Ruedemann.

(See plates 10 and 11)

Page 32

Figures 1–3 Three growth stages of colonies.

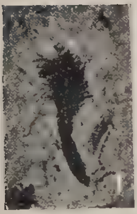
Figures 4, 5 Two specimens showing the usual appearance of the fossil.

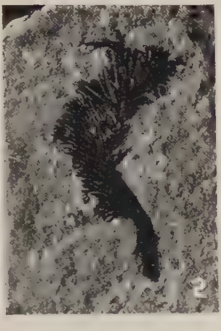
Figure 4 Type.

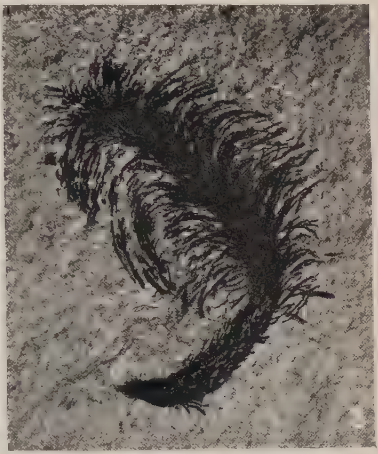
Figure 6 Specimen with traces of the larger distal thecal tubes. Cotype.

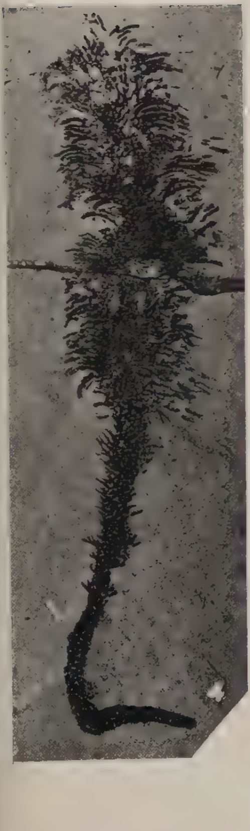
Lockport limestone (Gasport lens), at Gasport, N. Y.

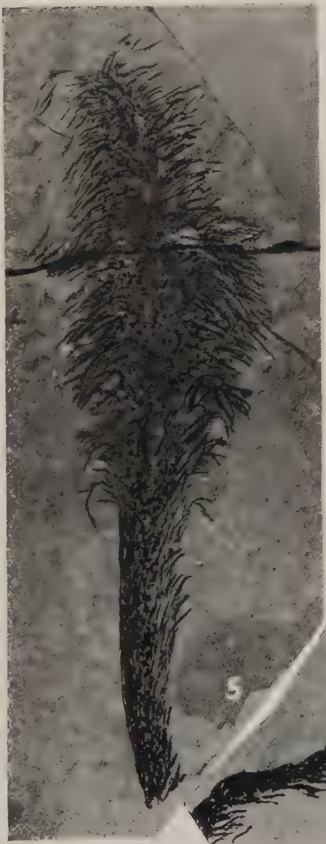
All figures are natural size. The originals are in the New York State Museum.

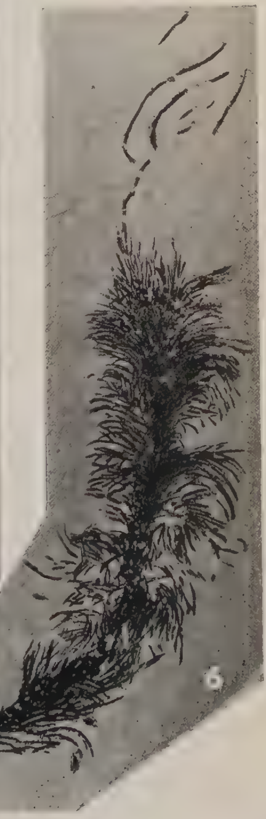












E. S. et E. P. photo., R. R. del.

Plate 10

Medusaegraptus mirabilis Ruedemann

(See plates 9 and 11)

Page 32

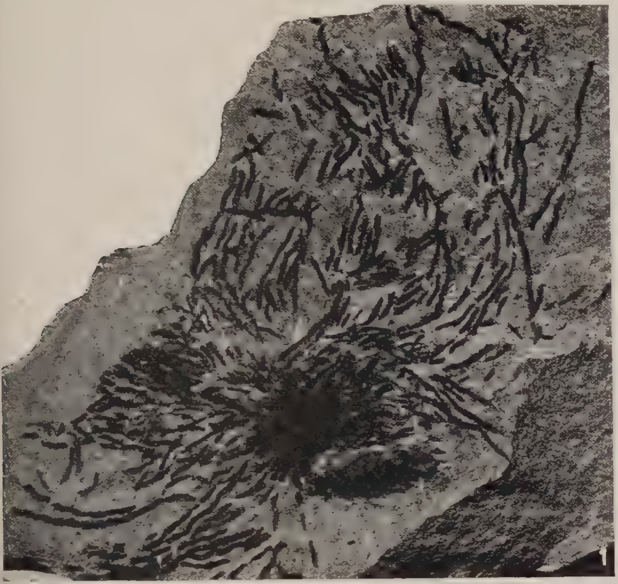
Figure 1 Distal portion of colony with radiating, flexuous, long thecal tubes, seen from above. Cotype.

Figure 2 Distal portion of stipe completely stripped of thecal tubes, showing the basal pores of the latter. Cotype.

Figure 3 Specimen retaining both the earlier thecal tubes along the stipe and the longer and thicker terminal ones. Cotype.

Figure 4 Specimen in which the stipe has become smooth and thickened save the distal portion, probably the last stage of the colony. Cotype.

Lockport limestone (Gasport lens), at Gasport, N. Y.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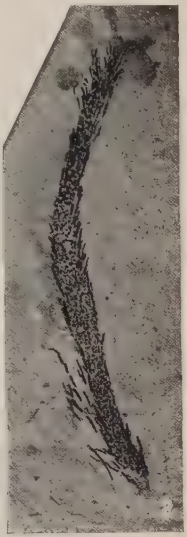
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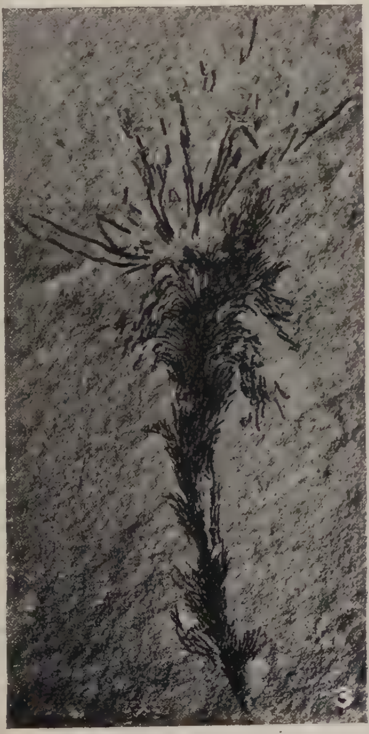
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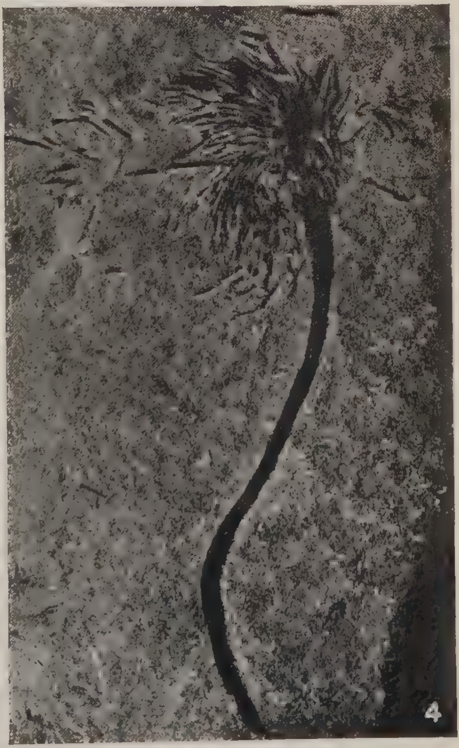
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E. S. et E. P. photo., R. R. del.

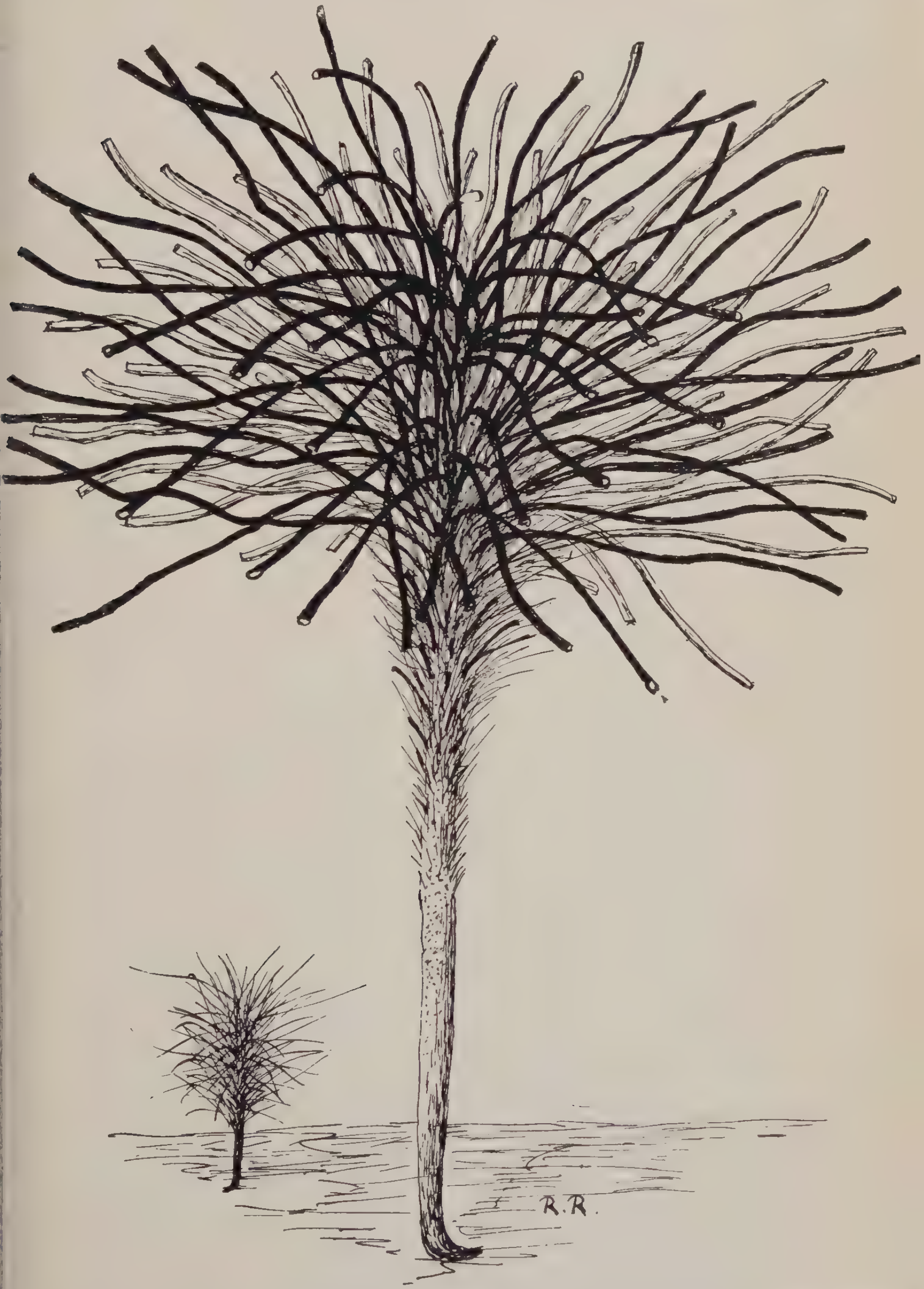
Plate 11

Medusaegraptus mirabilis Ruedemann.

(See plates 9 and 10)

Page 32

Figure 1 Restoration of mature colony in natural size.



R. R.

Plate 12

Inocaulis lesquereuxi (Grote and Pitt)

Page 27

Figure 1 Detached branch showing club-shaped swelling of terminal portion. Natural size.

Figure 2 Large, perfectly preserved colonial stock. x ½.

Bertie waterlime, North Buffalo, N. Y.

Climacograptus ultimus Ruedemann

Page 37

Figure 3 Group of stipes, associated with leg spine of eurypterid. Natural size.

Figure 4 Stipe x 3.

Bertie waterlime, North Buffalo, N. Y.

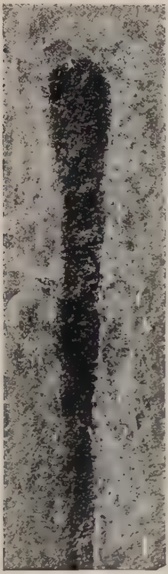
Orthograptus (?) sp.

Page 38

Figure 5 Single stipe observed. Natural size.

Bertie waterlime, North Buffalo, N. Y.

All originals are in the New York State Museum.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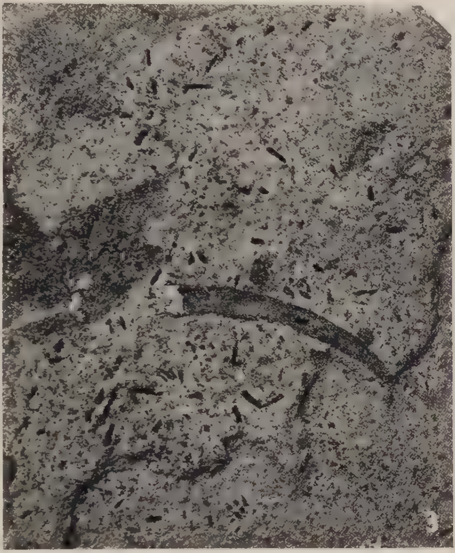
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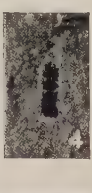
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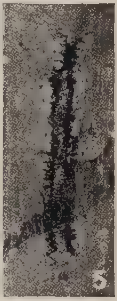
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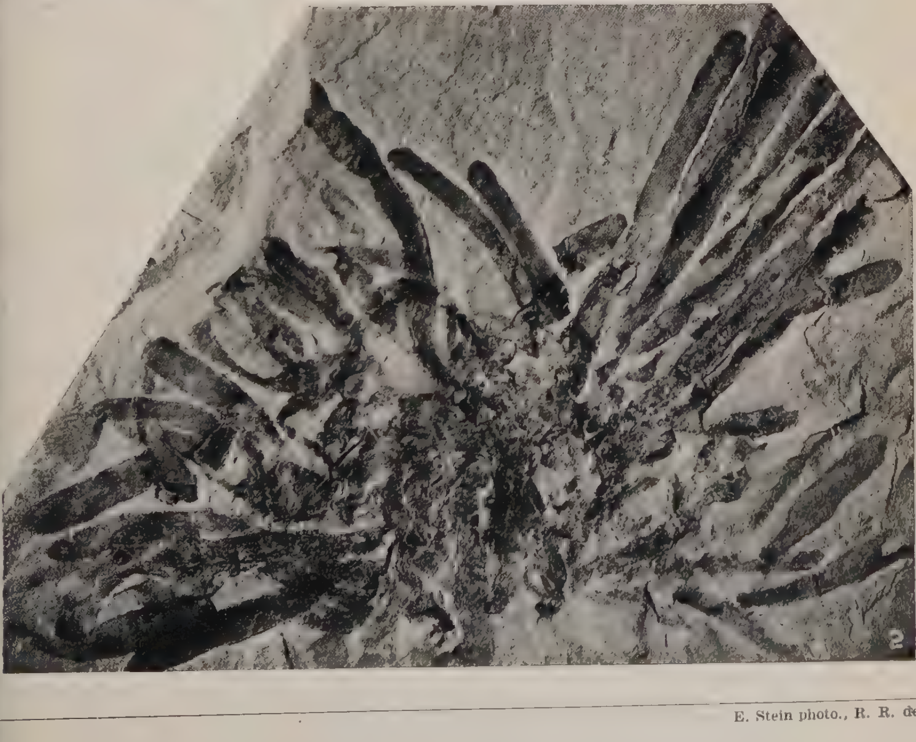
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E. Stein photo., R. R. del

Plate 13

Medusaegraptus graminiformis (Pohlman)

(See plate 8, figures 1–4)

Page 30

Figure 1 Restoration of complete colony. Natural size.

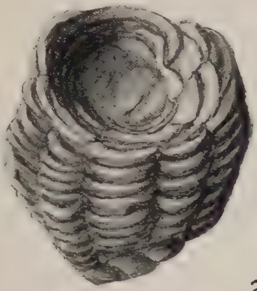
Pyrgocystis batheri Ruedemann

Page 39

Figures 2–5 Four views of type-specimen. Figure 2 View of short side. Figure 3 Top view. Figure 4 Long side. Figure 5 Base. x 6.

Bertie waterlime, North Buffalo, N. Y.

Original in New York State Museum.



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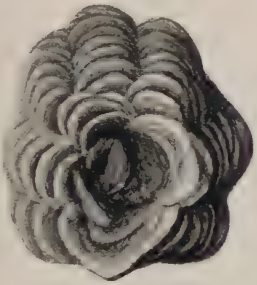

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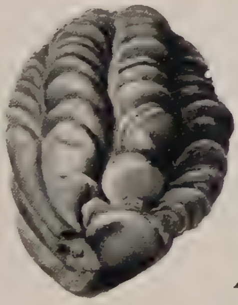

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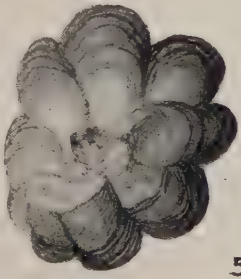

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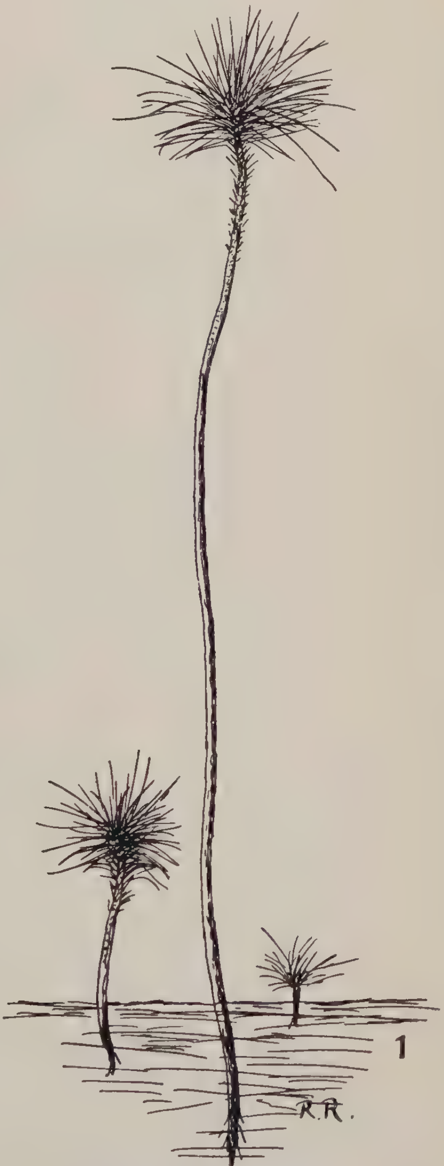

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R. R. et E. K. B. del.

Plate 14

Protoscolex batheri Ruedemann

Page 40

Figure 1 Well-preserved specimen with clitellum. Type.

Figure 2 Posterior fragment of specimen. Cotype.

Lockport limestone (Gasport lens), Gasport, N. Y.

Bertiella obesa Ruedemann

Page 43

Figure 3 Cotype, much contracted specimen.

Figure 4 Type; posterior extremity not fully preserved.

Bertie waterlime, North Buffalo, New York.

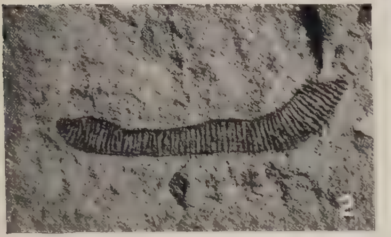
Excrementa

Page 45

Figure 5 Portion of slab covered with wormlike, structureless bodies, probably excrementa.

Bertie waterlime, North Buffalo, N. Y.

All figures are natural size. The originals of the figures are in the New York State Museum.



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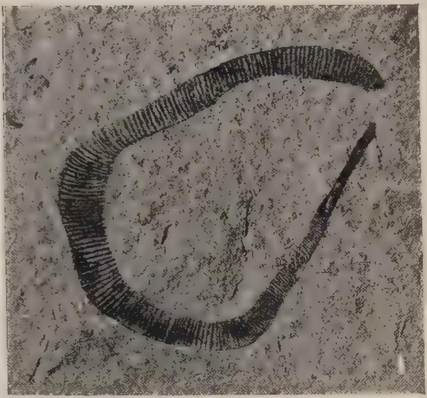

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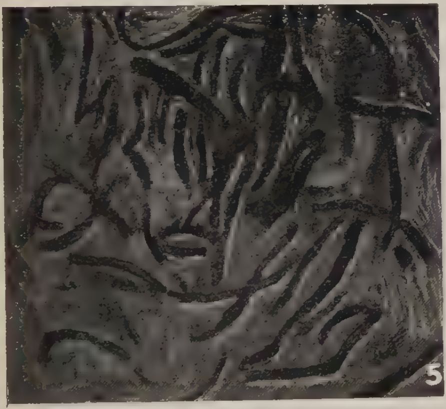

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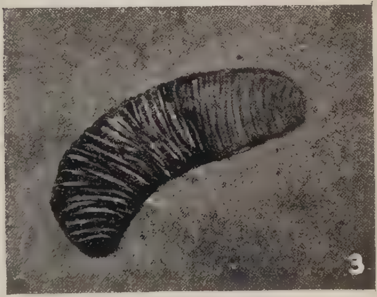

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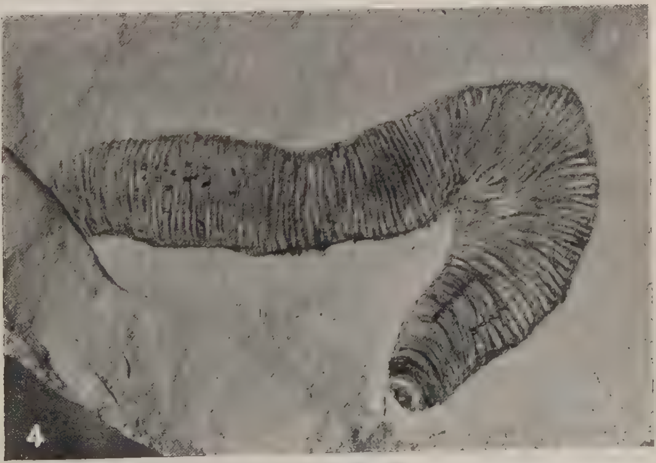

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E. S. et E. P. photo., R. R. del.

Plate 15

Lingula lamellata Hall

Page 46

Figure 1 Valve retaining color-bands, x 3.
Lockport limestone (Gasport lens), Gasport, N. Y.

Trematis spinosa Ruedemann

Page 49

Figure 2 Brachial valve. Holotype x 3.
Lockport limestone (Gasport lens), Gasport, N. Y.

Spirifer (Delthyris) eriensis Grabau.

Page 50

Figures 3, 4 Two valves, x 2, from the Bertie waterlime, North Buffalo, N. Y.

Ceratopora (?) sp.

Page 38

Figure 5 Portion of colony, seen in natural section on weathered surface. Natural size.
Bertie waterlime, North Buffalo, N. Y.

Rhytimya buffaloensis Ruedemann.

Page 51

Figures 6, 7 Cotypes. x 2.
Bertie waterlime, North Buffalo, N. Y.

Hercynella buffaloensis O'Connell

Page 52

Figures 8, 9 Top and side views of complete specimen. Natural size.
Bertie waterlime, North Buffalo, N. Y.

Loxonema (?) **bertiense** Ruedemann.

Page 54

Figure 10 Holotype, natural size.
Bertie waterlime, North Buffalo, N. Y.

Serpulites corrugatus Ruedemann.

Page 70

Figure 11 Holotype x 3.
Rochester shale, Niagara river gorge.

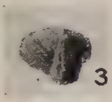
Dactylethra conspicua Ruedemann

Page 44

Figure 12 Type specimen. Natural size.
Lockport limestone (Gasport lens), Gasport, N. Y.

All originals are in the New York State Museum, save that of figure 10 which is in the Buffalo Museum.

SILURIAN FOSSILS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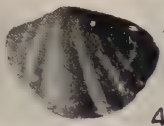
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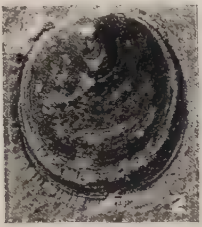
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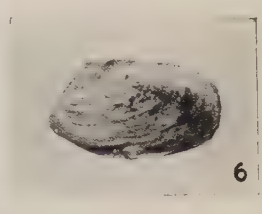
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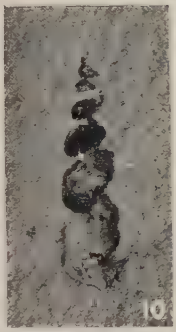
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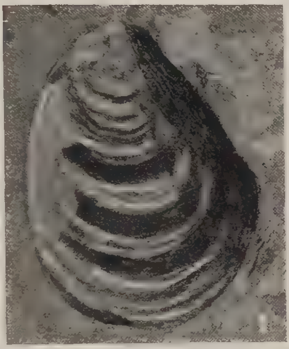
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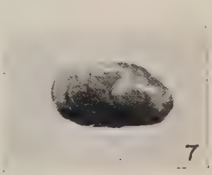
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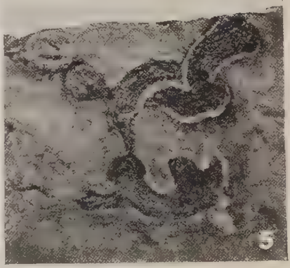
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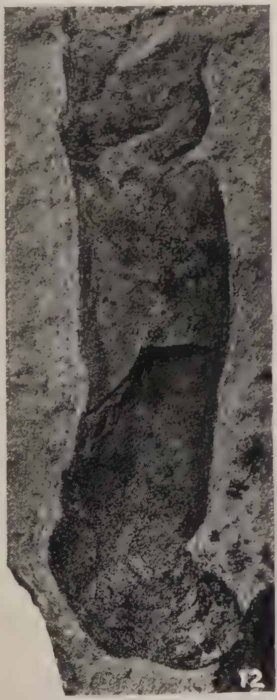
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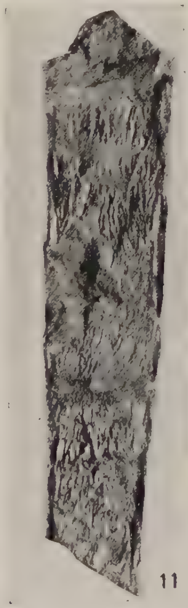
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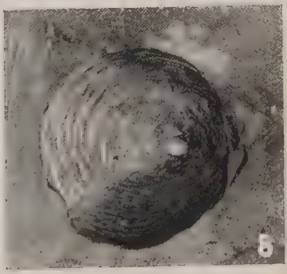
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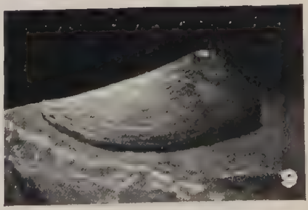
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Plate 16

Figure 1 Portion of large rootlike plant remains (see p. 17) from the Bertie waterlime at Buffalo. x½.

Dawsonoceras oconnellae Ruedemann.

Page 56

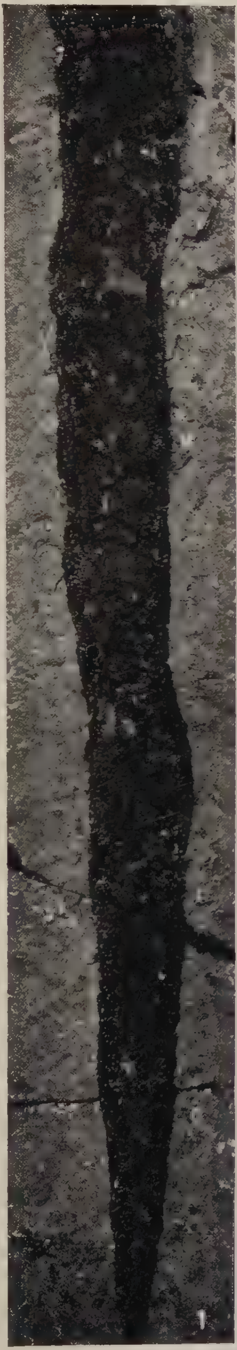
Figure 2 Holotype. x ⅔. Bertie waterlime, North Buffalo, N. Y.

Orthoceras sp.

Page 55

Figure 3 Portion of specimen, showing color-bands. Natural size. Bertie waterlime, North Buffalo, N. Y.

The originals of figures 1 and 2 are in the Buffalo Museum, that of figure 3 is in the New York State Museum.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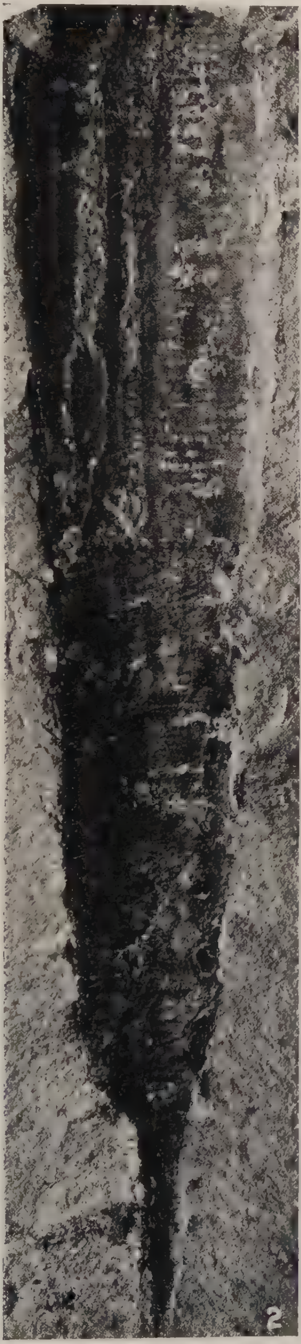
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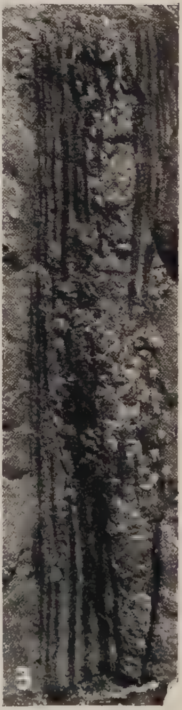
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E. Stein photo.

Plate 17

Mitroceras gebhardi (Hall)

(See plate 19, figure 2)

Page 63

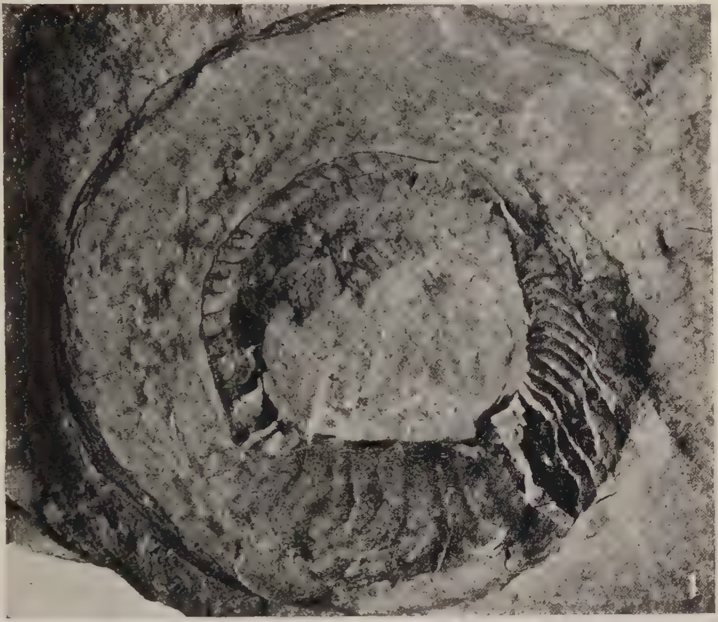
Figure 1 Compressed specimen from the Bertie waterlime at Buffalo, referred with doubt to this species (see p. 65).

Trochoceras cf. **anderdonense** Grabau

Page 57

Figure 2 One of two specimens obtained in Bertie waterlime at Buffalo.

The reproductions are in natural size; the original of figure 1 is in the Buffalo Museum, that of figure 2 is in the New York State Museum.



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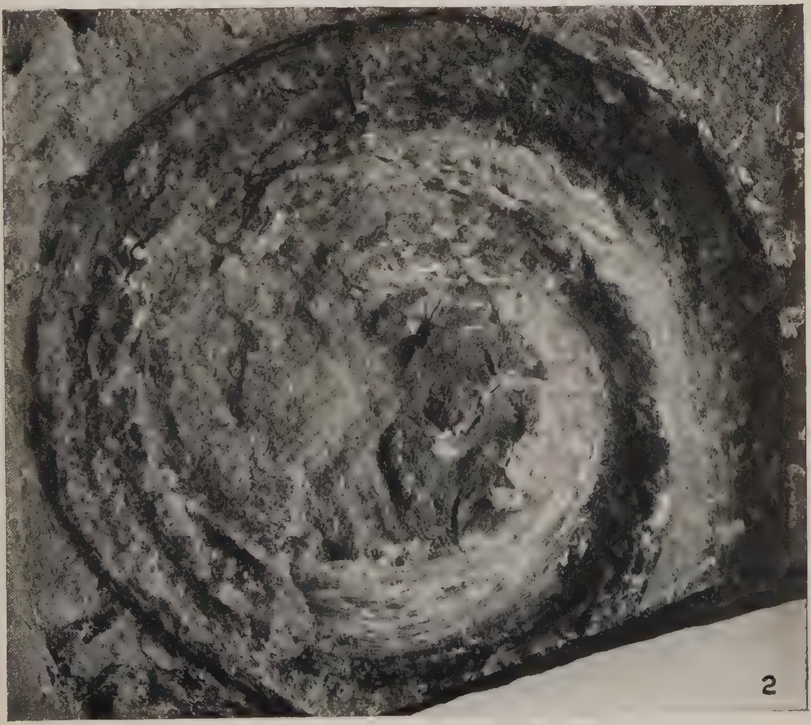

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E. Stein photo.

Plate 18

Pristeroceras timidum Ruedemann

Page 57

Figure 1 Top view of specimen showing the lobes or lateral sinuses of the brachial area and the teeth of the hyponomic slit.

Figure 2 Same, retaining the margin of hyponomic funnel.

Figure 3 Carbonaceous film, showing distinctly the outline of one-half of brachial area and of hyponomic slit of large specimen.

Figure 4 Living chamber obliquely compressed, showing distinctly alternating teeth of hyponomic slit.

Figure 5 Lateral view of conch with edge of aperture and hyponomic funnel (at right), showing relative size of living chamber.

Figure 6 Outline of specimen, completely flattened by lateral compression; and supposed to give a fairly accurate lateral view of conch, showing hyponomic funnel at right.

Figure 7 View of laterally compressed specimen, showing outline of living chamber and margin of aperture, with hyponomic funnel.

All figures are natural size. The originals of the figures are in the New York State Museum.

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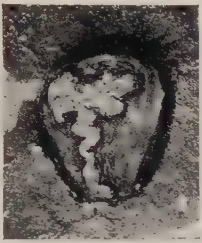
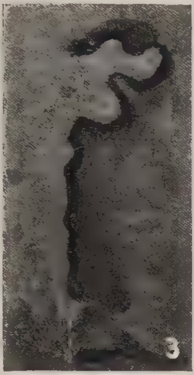
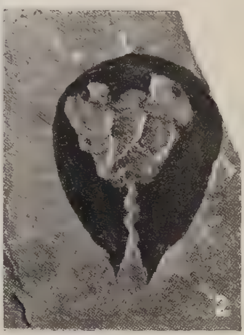
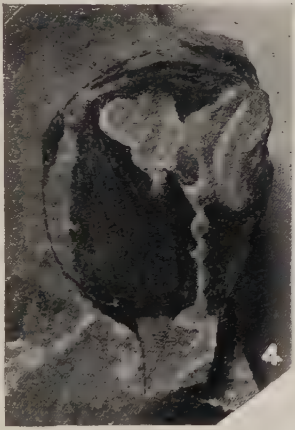
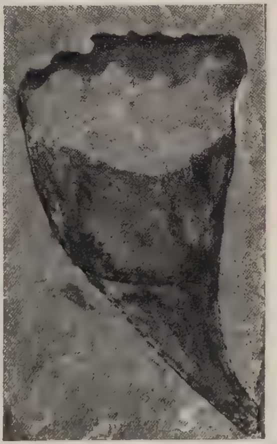
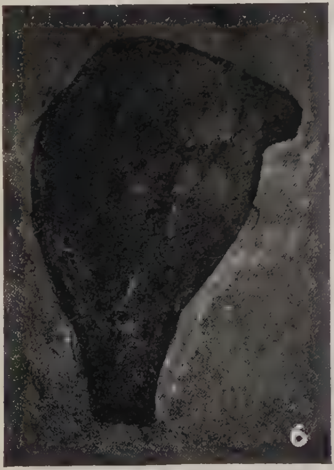


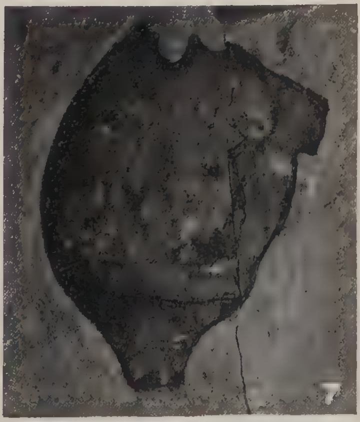












E. S. et E. P. photo., R. R. del.

Plate 19

Foersteoceras turbinatum (Hall)

(See plate 20, figure 1; plate 21, figures 1 and 2)

Page 65

Figure 1 Specimen showing siphuncle in upper volution. Natural size.

Cobleskill limestone. Schoharie, N. Y.

Mitroceras gebhardi (Hall)

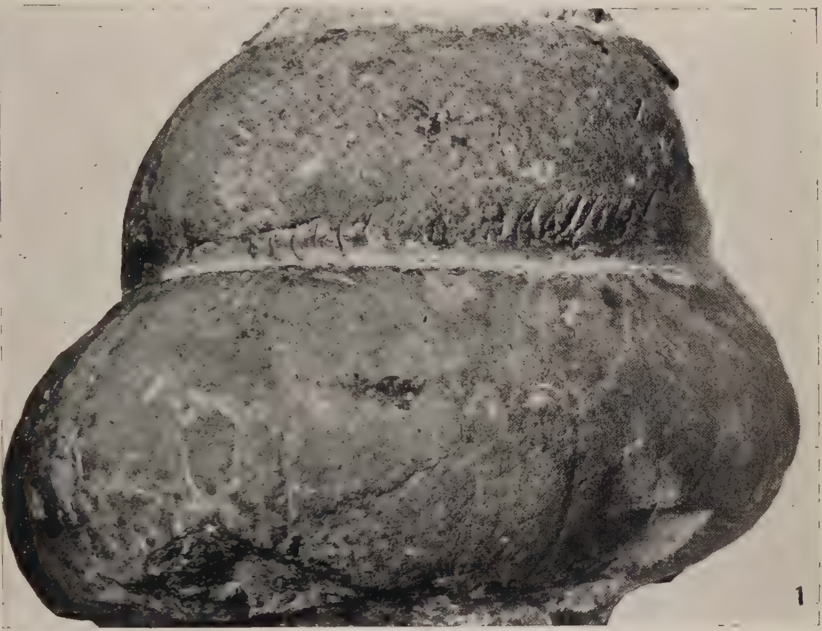
(See plate 17, figure 1)

Page 63

Figure 2 Underside of holotype. Natural size.

Cobleskill limestone. Schoharie, N. Y.

The originals are in the New York State Museum.



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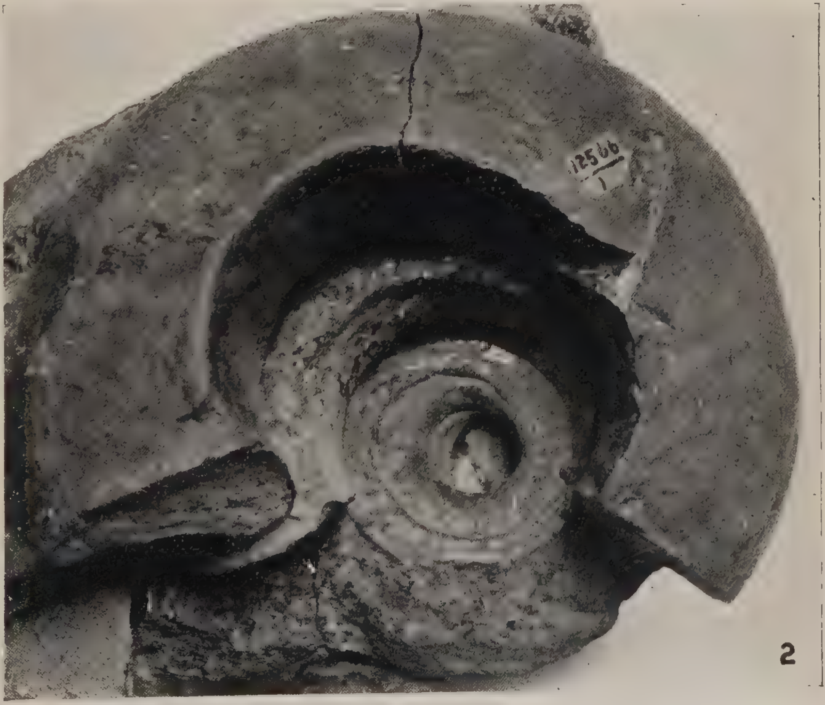

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E. Stein photo.

Plate 20

Foersteoceras turbinatum (Hall)

(See plate 19, figure 1; plate 21, figures 1 and 2)

Page 65

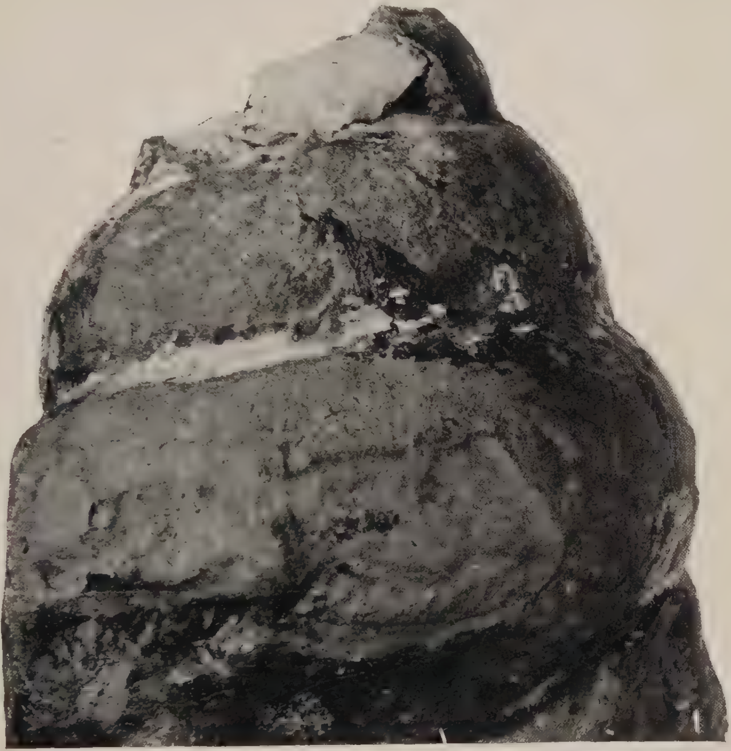
Figure 1 Upper portion of holotype, showing siphuncle at left of lower volution. Natural size.

Cobleskill limestone, Schoharie, N. Y.

Figure 2 Slab of Cobleskill limestone, showing its composition of coral stocks. x$\frac{1}{3}$.

Schoharie county, N. Y.

The originals are in the New York State Museum.



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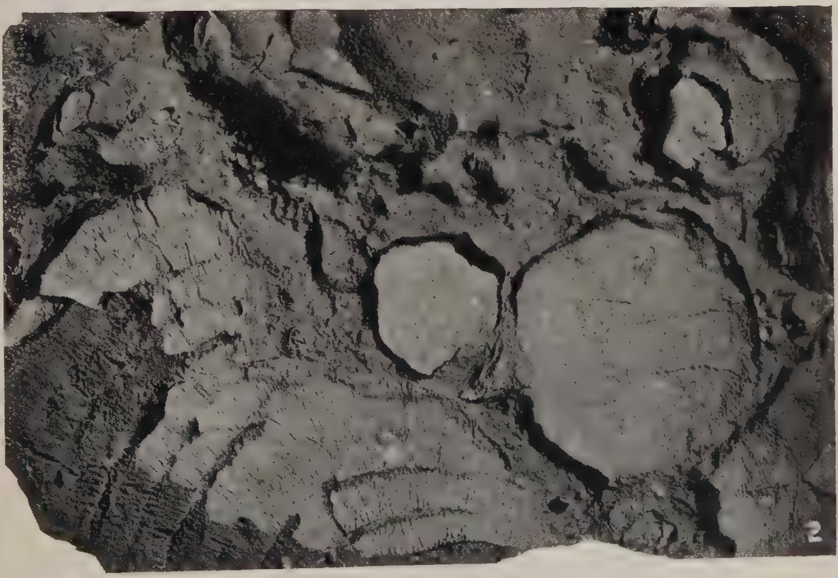

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E. Stein photo.

Plate 21

Foersteoceras turbinatum (Hall)

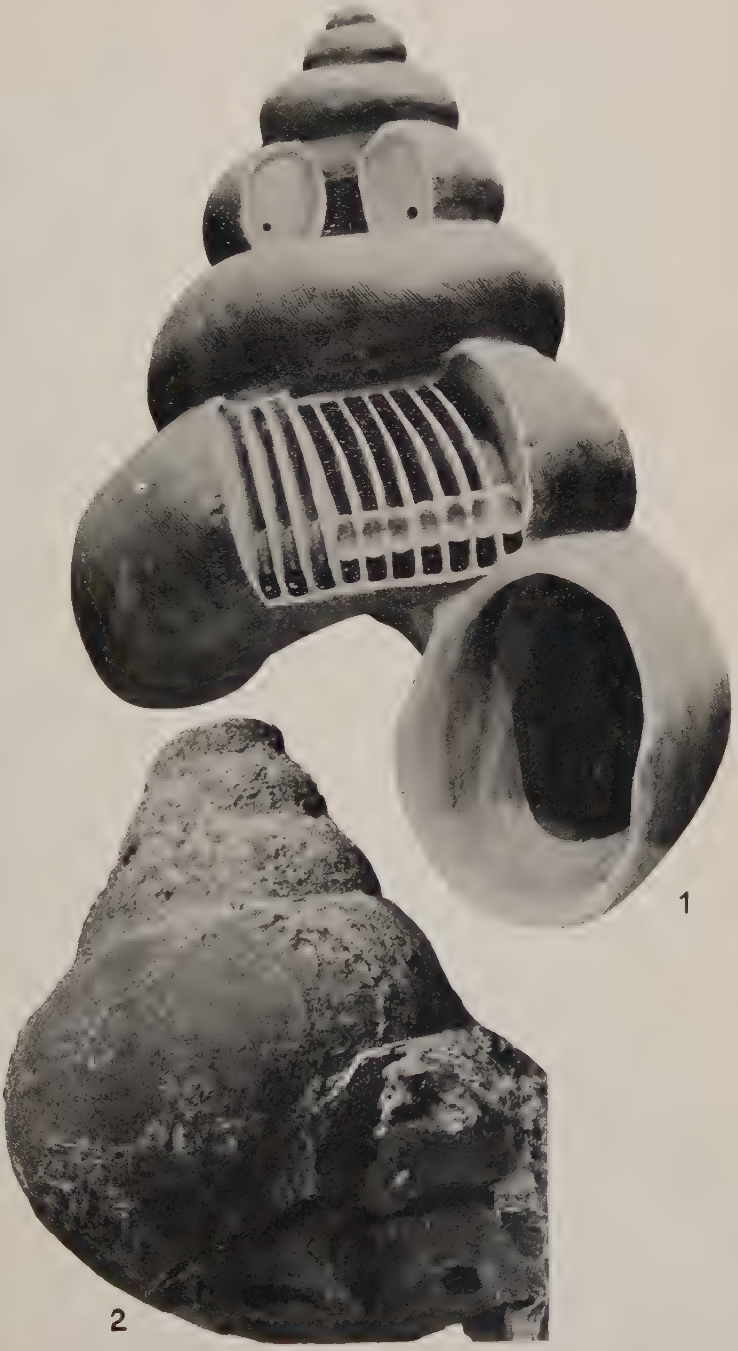
(See plate 19, figure 1; plate 20, figure 1)

Page 65

Figure 1 Photograph of a model made by the author.

Figure 2 A doubtful specimen from the Akron dolomite at Buffalo, referred to Mitroceras gebhardi by A. W. Grabau (see p. 64).

The original of figure 1 is in the New York State Museum, that of figure 2 is in the Buffalo Museum.



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E. Stein photo

Plate 22

Conularia tenuicosta Ruedemann

Page 68

Figure 1 Well preserved specimen. Type x 2.

Figure 2 Enlargement, x 3 of portion of specimen to show fine costae.

Figure 3 Two specimens connected near apices. Natural size.

Lockport limestone (Gasport lens), Gasport, N. Y.

Conularia filicosta Ruedemann

Page 69

Figure 4 Holotype. x 2.

Rochester shale, Niagara river gorge.

Conularia perglabra Ruedemann

Page 69

Figure 5 Cotype. Natural size.

Figure 6 The type. Natural size.

Bertie waterlime. North Buffalo, N. Y.

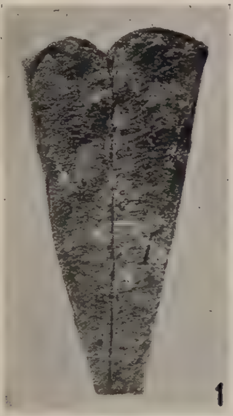
Conularia cataractensis Ruedemann

Page 67

Figure 7 Holotype. x 2.

Whirlpool sandstone member of Cataract formation, Niagara river gorge.

The originals of all figures are in the New York State Museum.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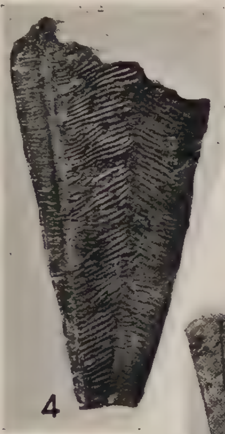
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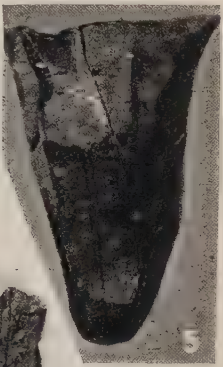
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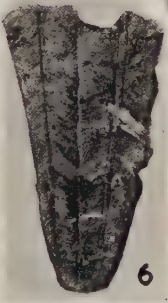
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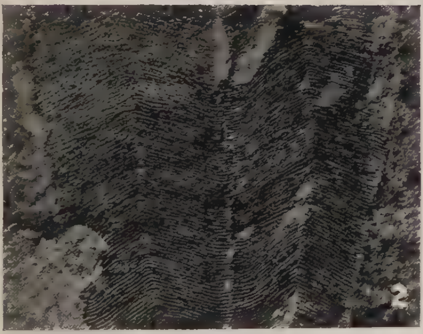
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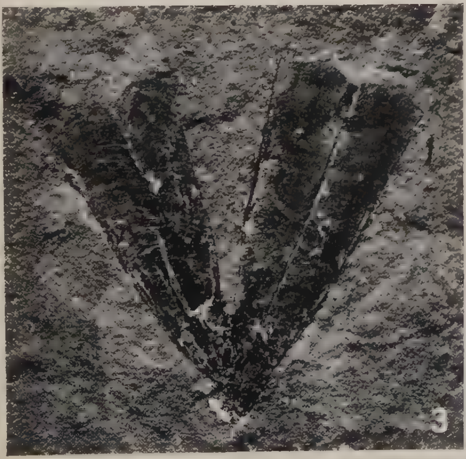
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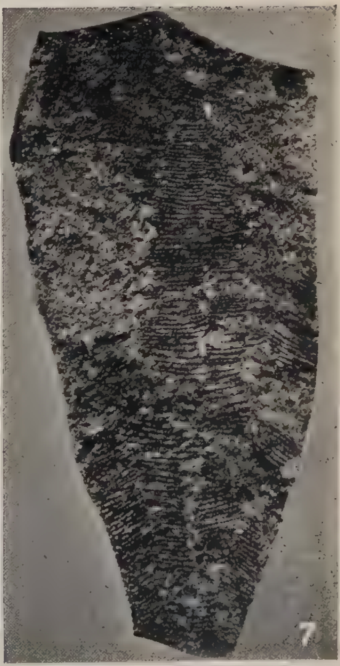
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Plate 23

Ceratiocaris acuminata Hall

Page 71

Figure 1 Telson of large individual.
Bertie waterlime. North Buffalo, N. Y.

Ceratiocaris clarkei Ruedemann

Page 73

Figure 2 Holotype. Drawn ventral side up.
Figure 3 " Mandible " (gastric teeth).
Figure 4 Cercopode.

All three specimens from the same small block of Bertie waterlime, found at Canandaigua, N. Y.

Lepidocoleus reinhardi Ruedemann

Page 76

Figure 5 Holotype.
Bertie waterlime. Williamsville near Buffalo, N. Y.

Anomalocaris (?) **kokomoensis** Ruedemann

Page 75

Figure 6 Holotype, x 9/10.
Kokomo waterlime, Kokomo, Ind.

Pterygotus sp.

Page 79

Figure 7 Ramus of pincer.
Akron dolomite (" Bullhead "), North Buffalo, N. Y.

All figures except figure 6 are drawn natural size. The originals of all figures are in the New York State Museum.

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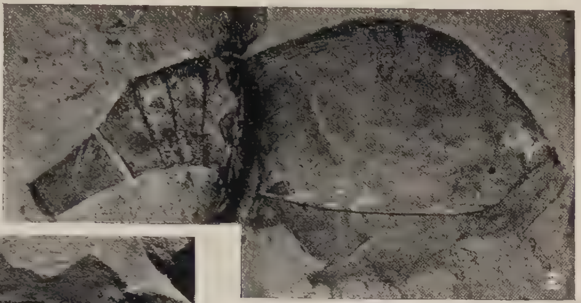

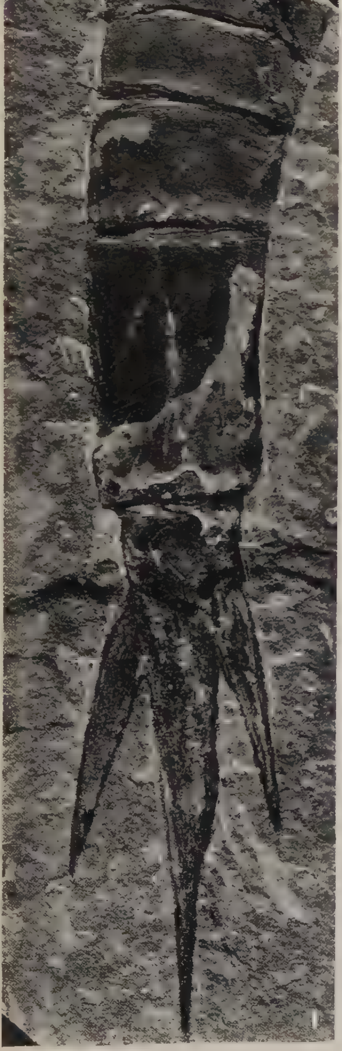

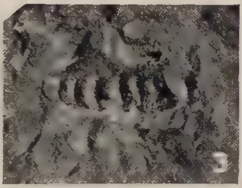

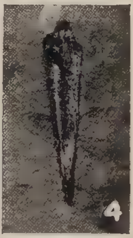

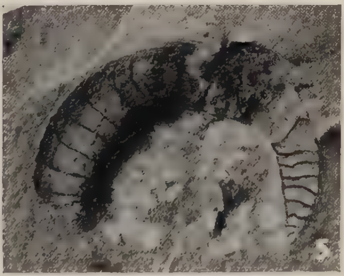

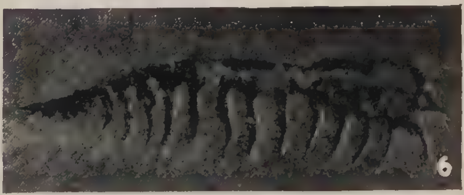

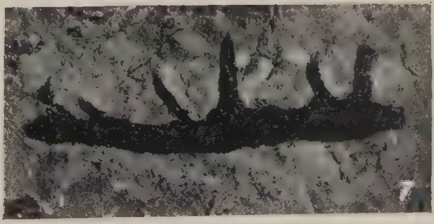

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Plate 24

Bunaia woodwardi Clarke

Page 79

Figure 1 Dorsal side of cephalothorax. x 8.

Figure 2 Ventral side of cephalothorax. x 8.

Figure 3 Crushed and defaced head shield with a postabdomen of ridged segments. x 8.

Figures 1–3 Copies of original figures.

Bertie waterlime, North Buffalo, N. Y.

Emmelezoe minuta Ruedemann

Page 74

Figure 4 Holotype. x 7.

Bertie waterlime, North Buffalo, N. Y.

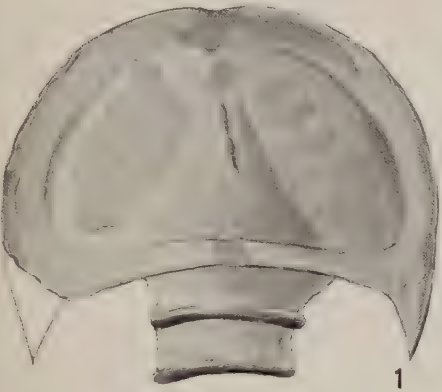
Eurypterus cf. **lacustris** Harlan

Page 80

Figure 5 Group of minute early growth stages of an eurypterid. x 7. See page 14.

Bertie waterlime, North Buffalo, N. Y.

The originals of the figures are in the New York State Museum, except that of figure 5, which is in the Buffalo Museum.



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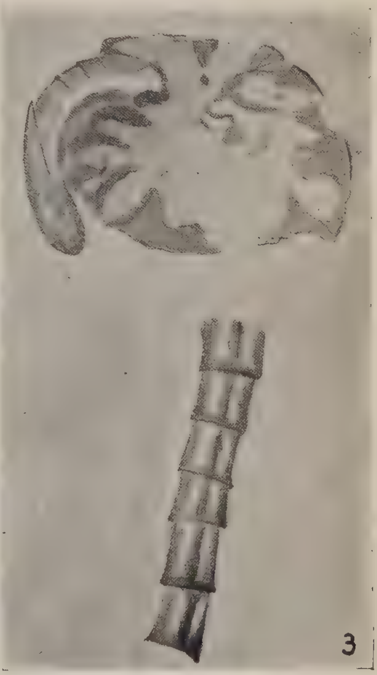

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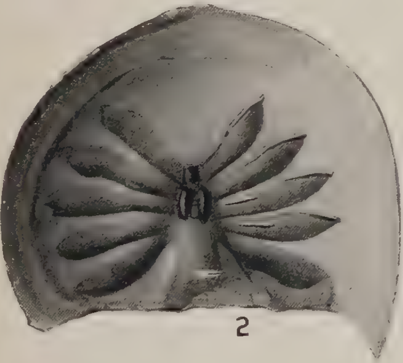

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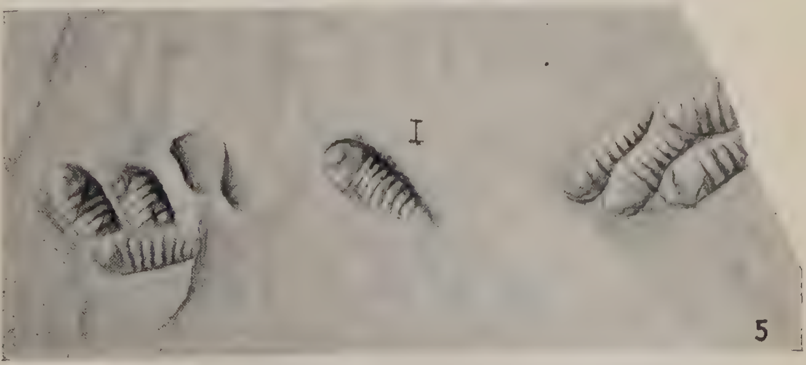

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